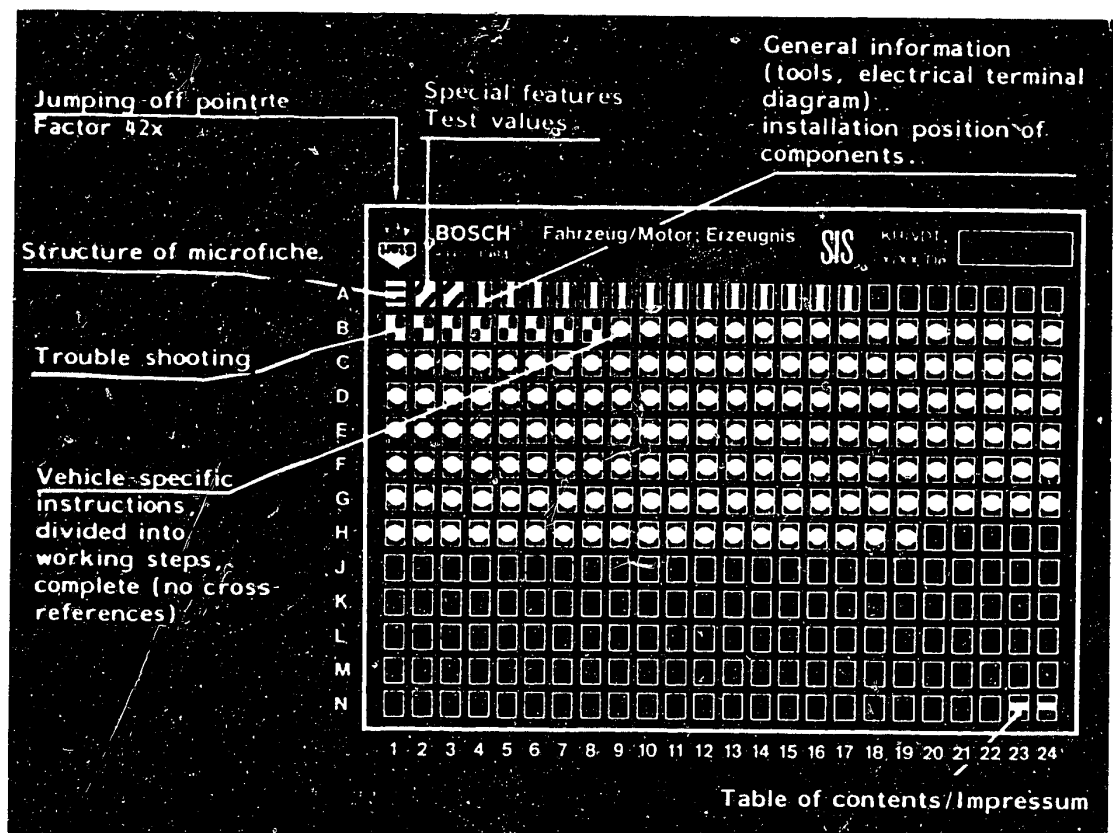


Structure of microfiche



1. Read from left to right
2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step
	Vehicle/engine

Coordinate

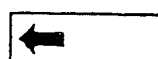
3. Limits of section



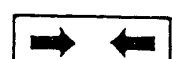
Beginning



Mid-section



End



One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.
5. Reference to relevant working steps in the test specifications, e.g. coordinate C6.

C6

A1

Trouble-shooting program



1. Special features

190 D 2.0 1 4-cylinder Europe version

190 D 2.2 1 4-cylinder USA version

with fuel-injection pump M... and RSF II governor.

2. Test specifications

2.1 Idle speed

700-800 min⁻¹

2.2 Injection timing

Dynamic: setting value - 15° ATDC at 750 ± 50 min⁻¹

checking value - 15 ± 1° ATDC at
750 ± 50 min⁻¹

Static: setting value - 24° BTDC

2.3 Idle increase

min. 100 min⁻¹ at approx. 500 mbar vacuum

2.4 Allowable pressure drop of vacuum system

from 500 to 400 mbar approx. 1 minute

2.5 Nozzle-opening pressure

new nozzles 115 - 125 bar

used nozzles min. 100 bar

2.6 Compression loss

max. 25%

2.7 Fuel delivery of supply pump

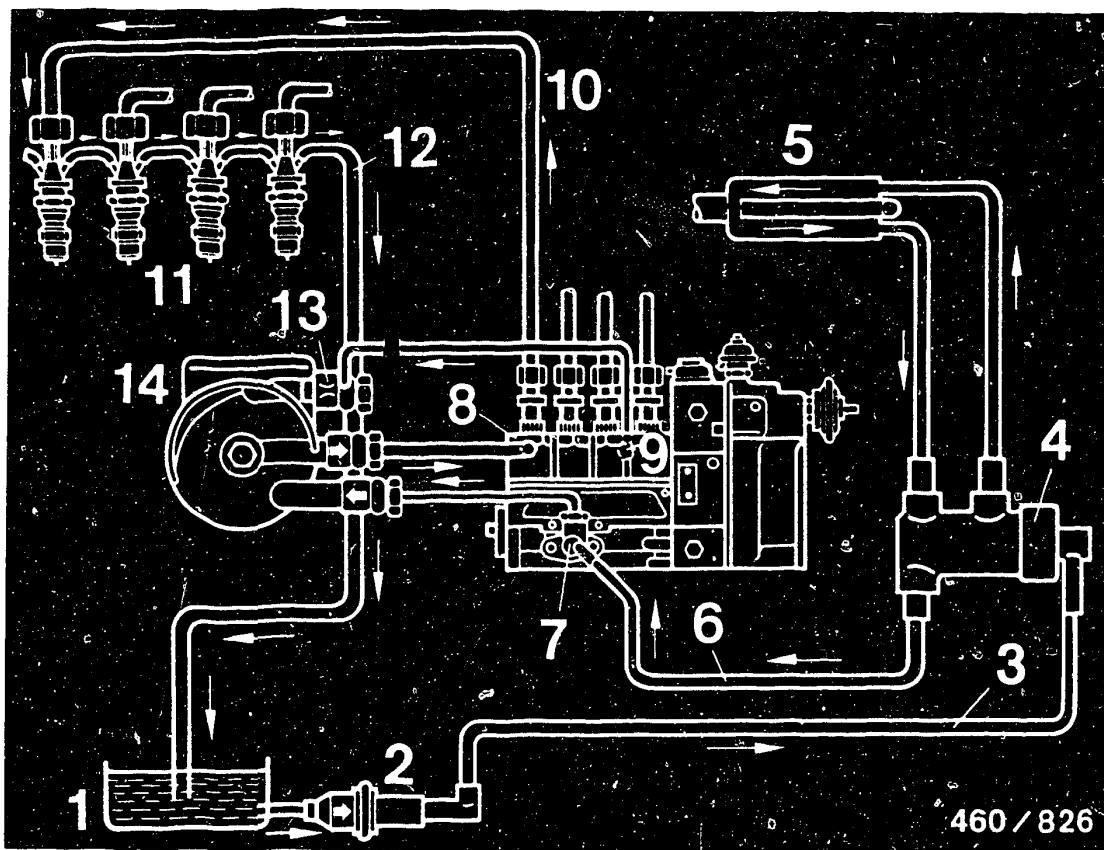
min. 200 ml/30 sec. at cranking speed
(stop lever depressed).



2.8 Tightening torques

Injection line	10 - 20 Nm
Injection-pump flange	20 - 25 Nm
Central fastening screw on timing device (left-hand thread)	40 - 50 Nm
Screw plug on governor for dynamic start-of-delivery setting	30 - 35 Nm
Nozzle-and-holder assembly	70 - 80 Nm
Delivery-valve holder	35 Nm
Nozzle-retaining nut	70 - 90 Nm
Fan fastening screw	25 Nm
Rod-type glow plugs	20 Nm
Chain tensioner	80 Nm





- | | |
|---|---|
| 1 = Fuel tank | 8 = Injection pump |
| 2 = Fuel prefilter | 9 = Overflow valve with
1.5 mm Ø restriction |
| 3 = Inlet line - cold
fuel | 10 = Injection line -
cylinder 1 |
| 4 = Fuel thermostat | 11 = Injection nozzles |
| 5 = Heating flow pipe with
fuel heat exchanger | 12 = Leak-off line |
| 6 = Return line - pre-
heated fuel | 13 = Restriction bore
0.8 mm Ø |
| 7 = Supply pump | 14 = Fuel filter top part |

3. Diagram of lines

3.1 Diagram of fuel lines

The fuel lines are connected in accordance with the above diagram. The fuel flows in the direction of the arrows.



Note on fuel preheating

A fuel heat exchanger is installed in the inlet line to preheat the fuel. The fuel thermostat regulates the inlet quantity through the heat exchanger or directly to the supply pump on the injection pump.

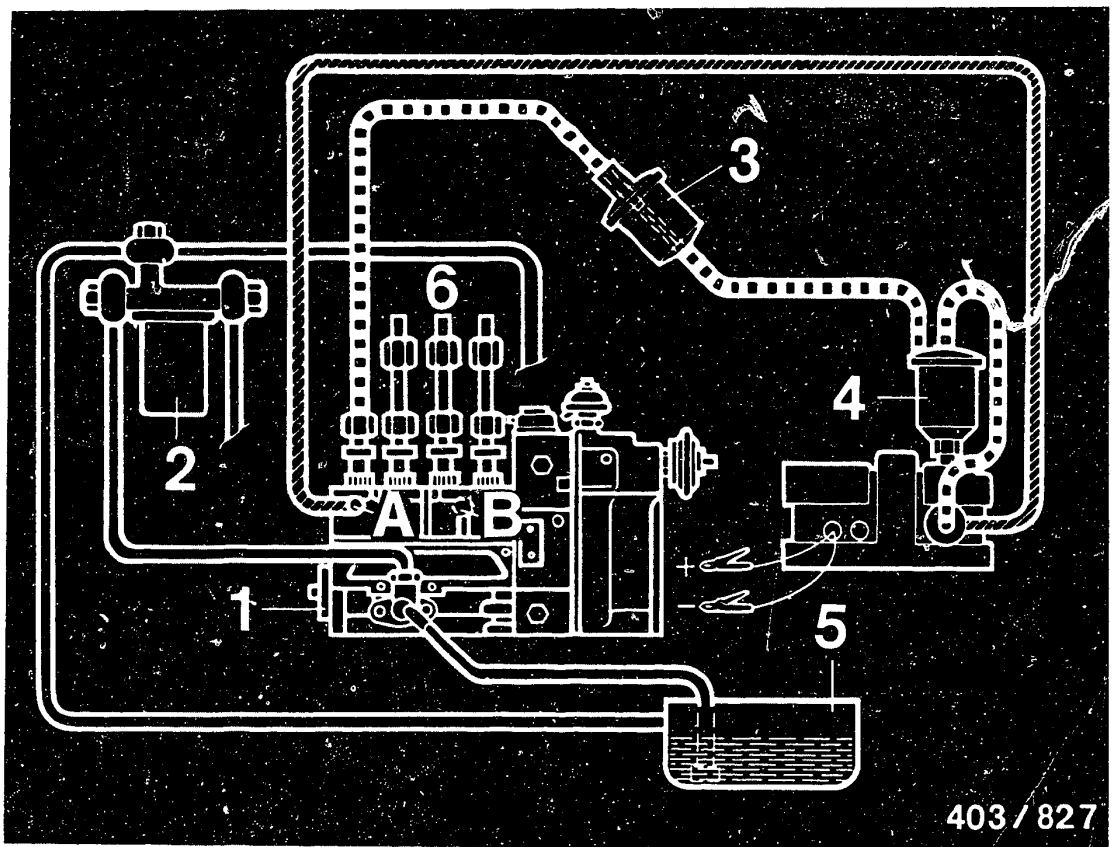
Up to $+8^{\circ}\text{C}$ the entire fuel flow is directed through the fuel heat exchanger.

Between $+8^{\circ}\text{C}$ and $+25^{\circ}\text{C}$ the fuel is blended depending on temperature.


Above $+25^{\circ}\text{C}$ the inlet bore to the fuel heat exchanger is closed by the thermostat.

The fuel flows directly to the supply pump on the injection pump.





 Return line

 High pressure approx. 30 + 4 bar

- 1 = Injection pump
- 2 = Fuel filter
- 3 = Sight glass
- 4 = Start-of-delivery setting device
- 5 = Fuel tank
- 6 = Pressure-limiting valves

- A = Inlet-union screw, fuel inlet from start-of-delivery setting device
- B = Seal fuel return line with screw plug.

3.2 Connection diagram for setting the start of delivery (static)

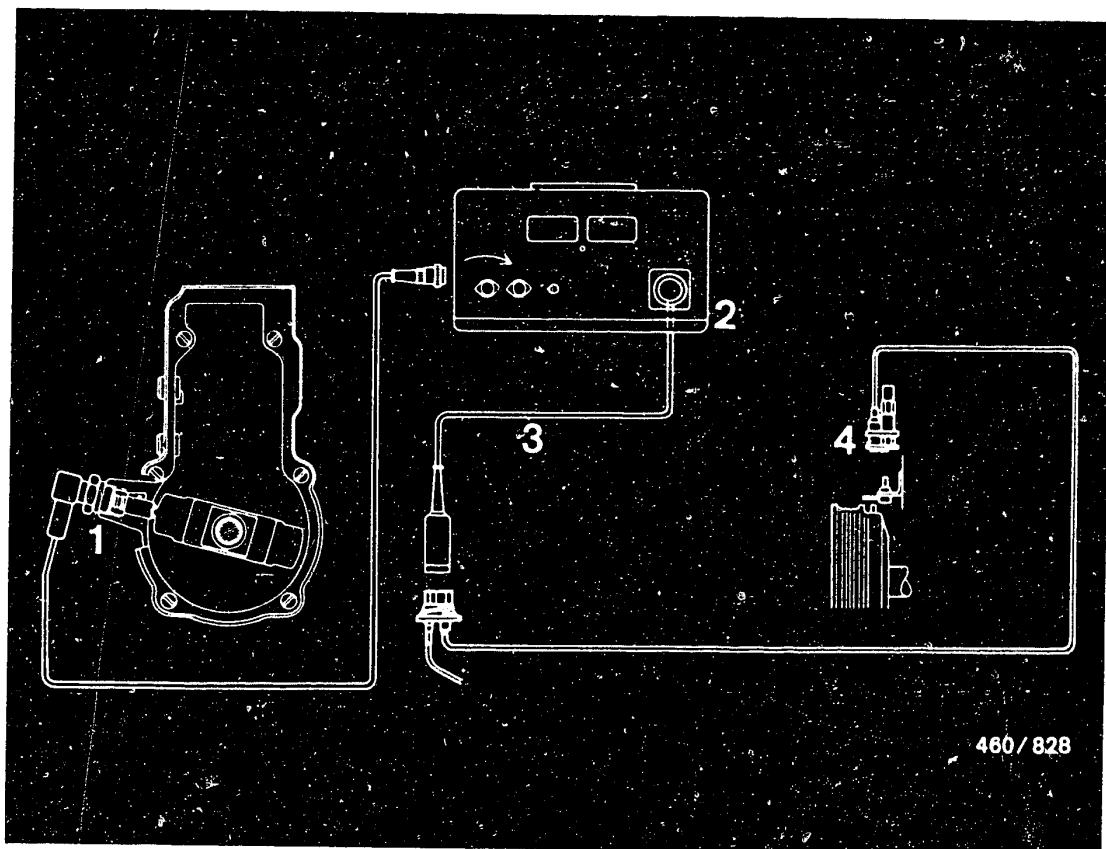
High-pressure overflow method

A6

Diagram of fuel lines/connection diagrams

Mercedes Benz 190 D

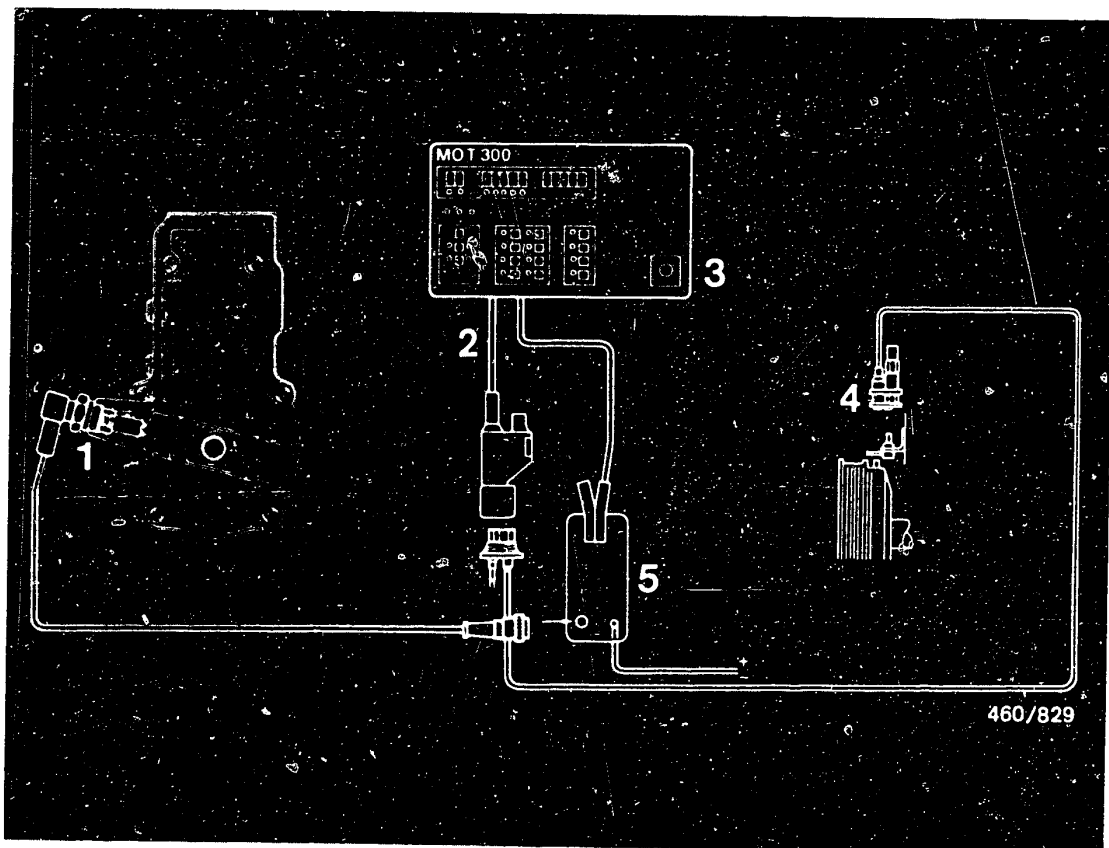




- 1 = Governor pulse generator - Daimler Benz Part No. 617 589 102 100
 2 = Diesel engine tester ETD 019.00 Bosch Part No. 0 684 101 900
 3 = Adapter lead Bosch Part No. 1 684 463 147
 4 = TDC pickup Daimler Benz Part No. 601 589 042 100

3.2.1 Connection diagram for dynamic testing of start of delivery with diesel engine tester ETD 019.00

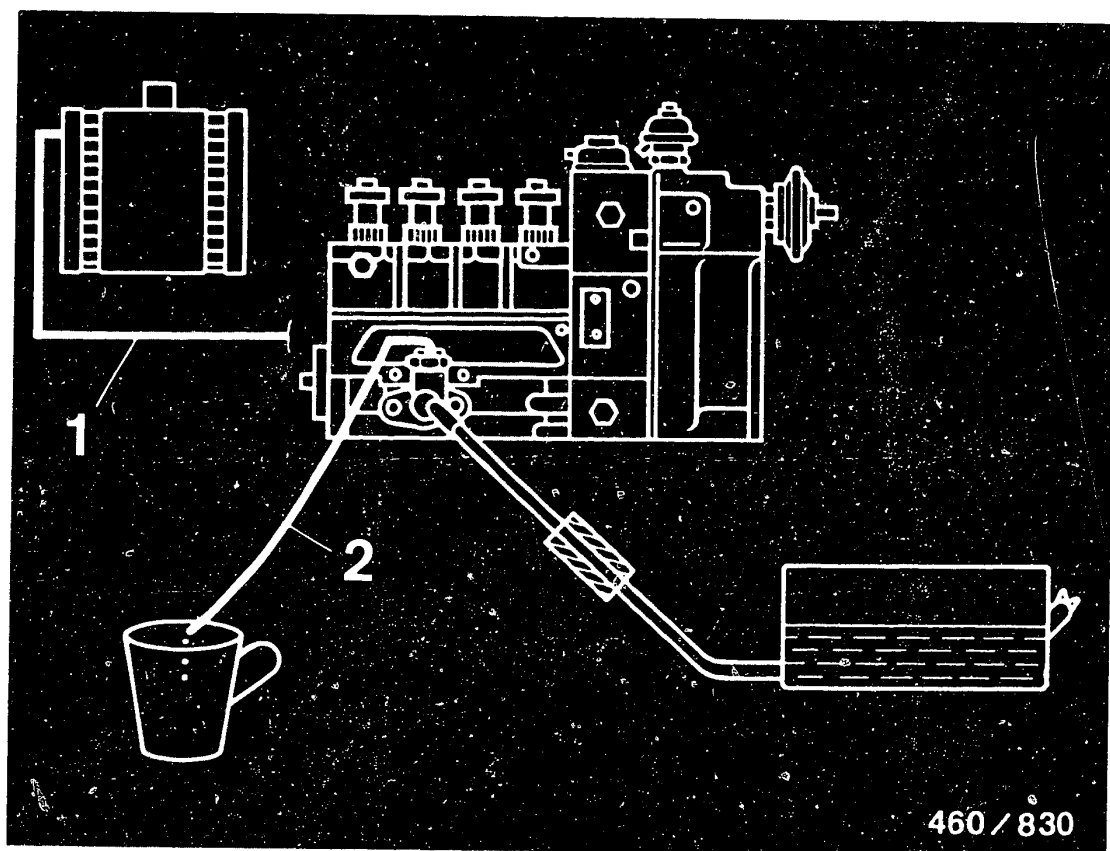




- 1 = Governor pulse generator, Daimler Benz Part No. 617 589 102 100
- 2 = Adapter lead, Bosch Part No. 1 684 463 094
- 3 = Motortester MOT 300, Bosch Part No. 0 684 000 300
- 4 = TDC pickup, Bosch Part No. not yet specified
- 5 = Ballast unit, Bosch Part No. not yet specified

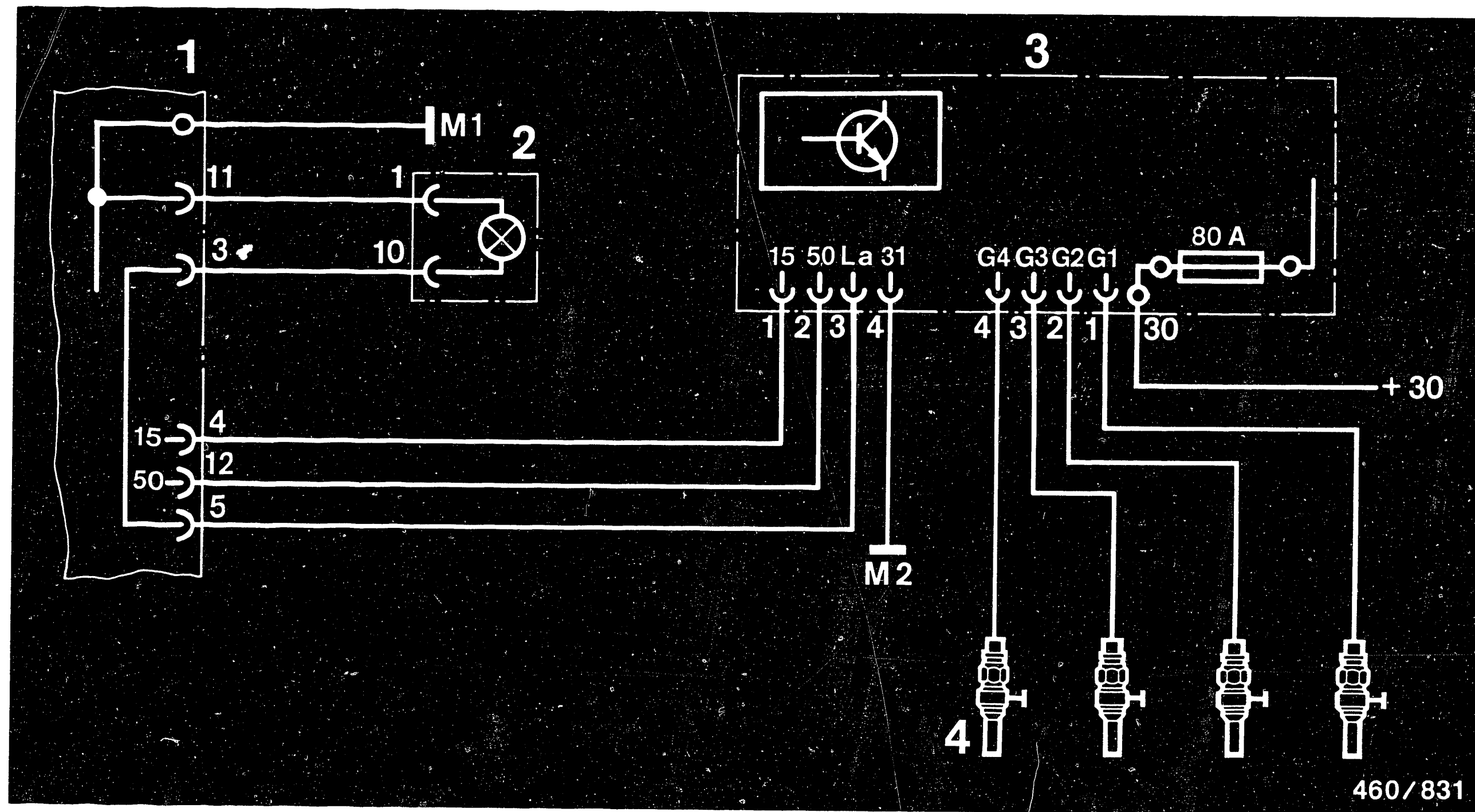
3.2.2 Connection diagram for dynamic testing of start of delivery with ballast unit and motortester (e.g. MOT 300)





1 = Pressure line
2 = Test line

3.3 Connection diagram for testing of supply pump



1 = Central-electrics console
 2 = Glow-plug indicator in instrument cluster
 3 = Glow-duration unit
 4 = Sheathed-element glow plugs

M 1 = Main ground behind instrument cluster
 M 2 = Ground front left (near lamp unit)

4. Terminal diagram for preheating system

A10

Terminal diagram - preheating system
 Mercedes Benz 190 D



A11

Terminal diagram - preheating system
 Mercedes Benz 190 D



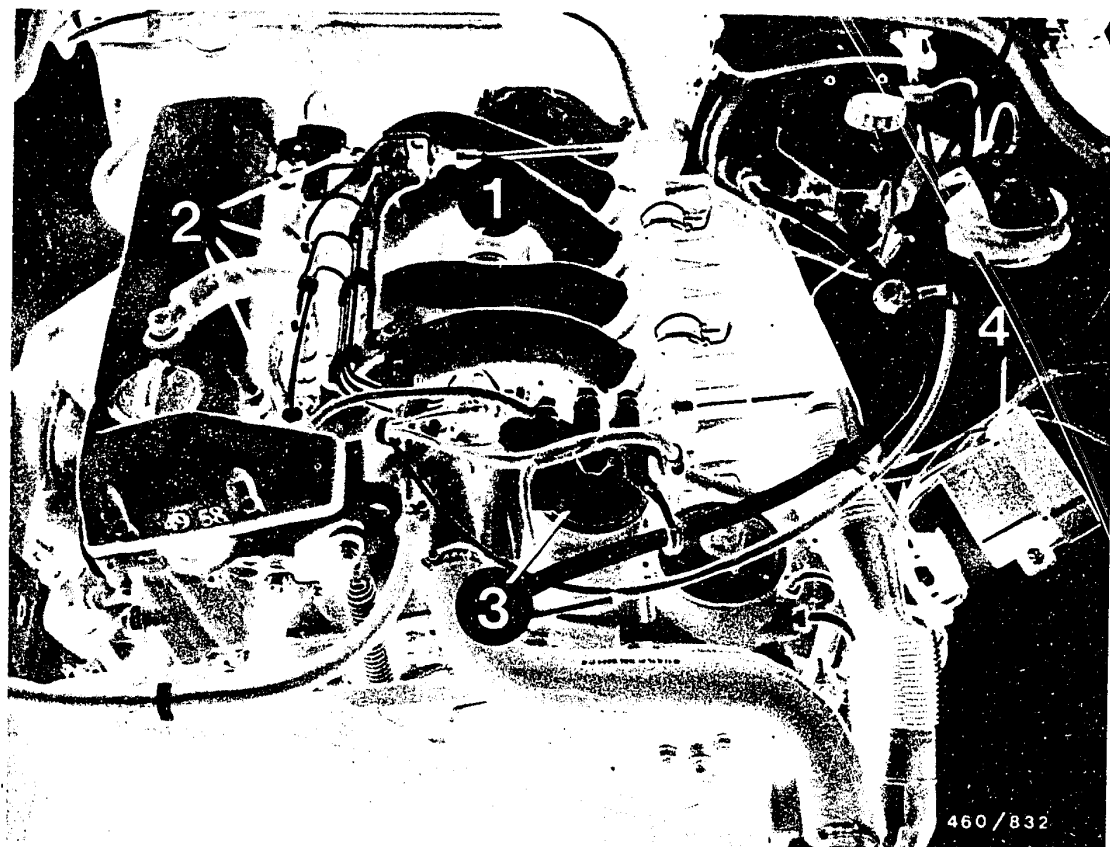
5. Test equipment and tools

Description	Part No.	Use
Nozzle tester	EFEP 60H 0 681 200 502	Testing injection nozzles
Compression tester	Commercially available	Testing engine compression
Compression-loss tester	EFAW 210A 0 681 001 901	Testing engine compression loss
Needle testing device	1 688 200 153	Testing longitudinal bore
Nozzle cleaner	KDEP 2900	For cleaning hole-type pintle nozzles
Smokemeter Accessories box with metering pump	0 684 102 050 0 681 169 038	Smoke test
Start-of-delivery setting device	KDEP-P200	Injection timing static
Connecting parts for KDEP-P200	KDEP-P200/50	Injection timing static
"Mityvac" hand vacuum pump	Korinth Ludwig-Kloos- strasse 21 6450 Hanau 7 (Steinheim)	Leak test



Description	Part No.	Use
Pressure/vacuum tester	ETT 007.01	Testing vacuum shutoff
Holding device	KDEP 1077	Locking flyweight
TDC pickup	601 589 042 100 (D.B. branch)	Setting idle speed
Diesel engine tester and special accessories adapter lead Governor pulse generator TDC pickup	ETD 019.00 1 684 463 147 617 589 102 100 601 589 042 100 (from D.B. branch)	Dynamic testing of start of delivery
Motortester e.g. MOT 300 with ballast unit Adapter lead Governor pulse generator TDC pickup	0 684 000 300 not yet specified 1 684 463 094 617 589 102 100 not yet specified	Dynamic testing of start of delivery
Tachometer (photoelectric)	Commercially available	Setting idle speed
Multimeter with digital display	Commercially available	Checking pre-heating system
Special wrench for injection line	Hazet 329 - 2 AF14	Loosening injection lines

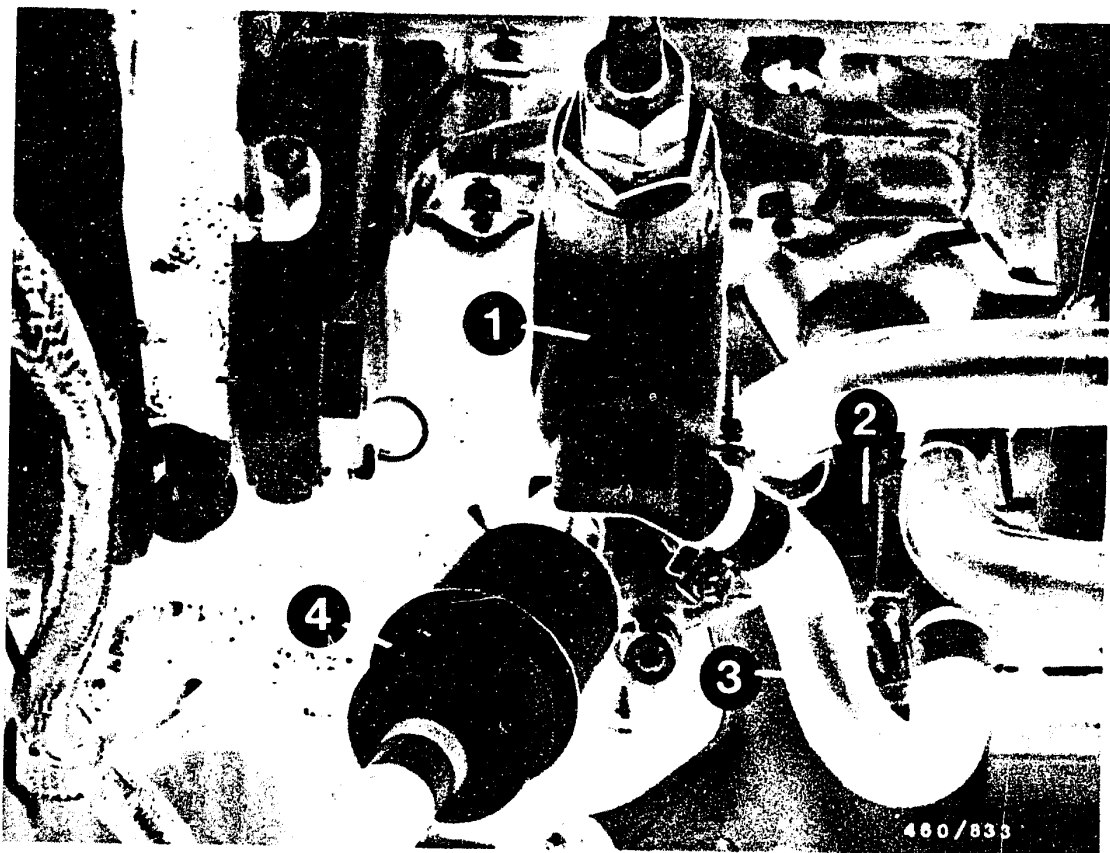




6. Installation position of components

- 1 = Injection pump (not visible in picture)
- 2 = Injection nozzles
- 3 = Fuel filter
- 4 = Glow-duration unit



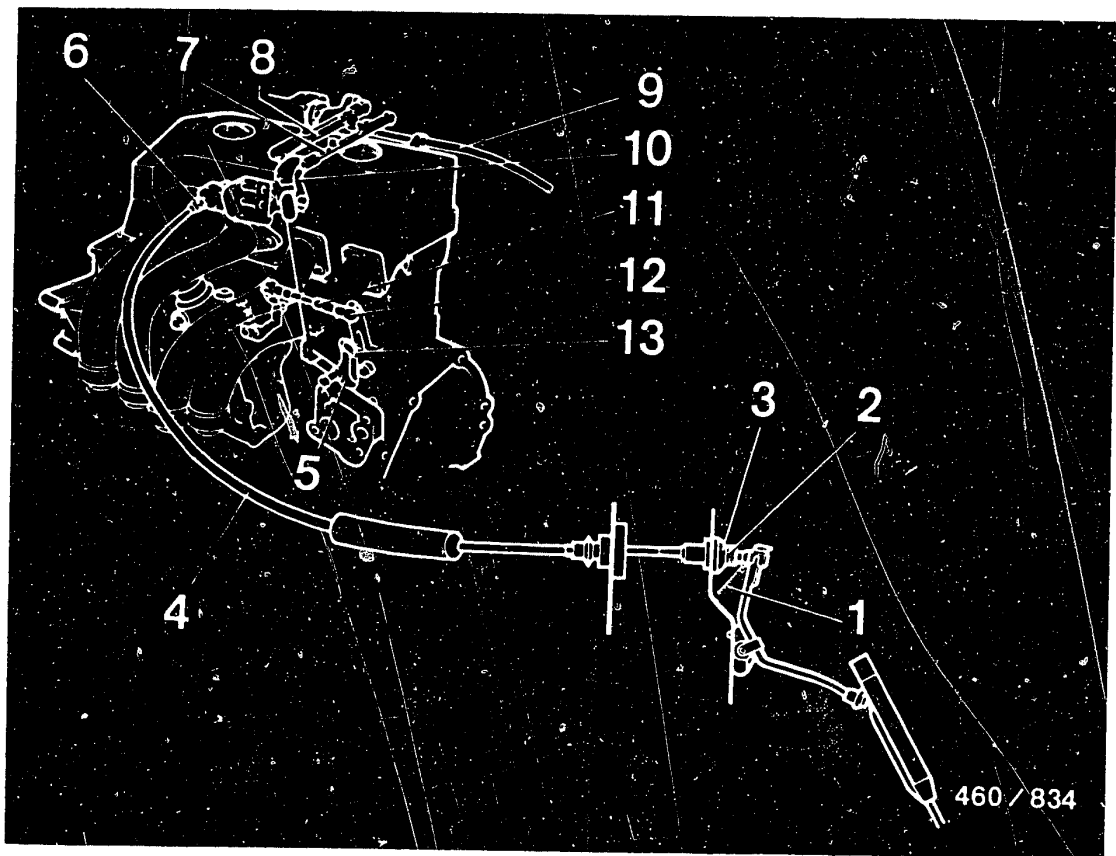


- 1 = Fuel-supply pump
- 2 = Fuel thermostat
- 3 = Suction line
- 4 = Fuel prefilter

A15

Installation position of components
Mercedes Benz 190 D

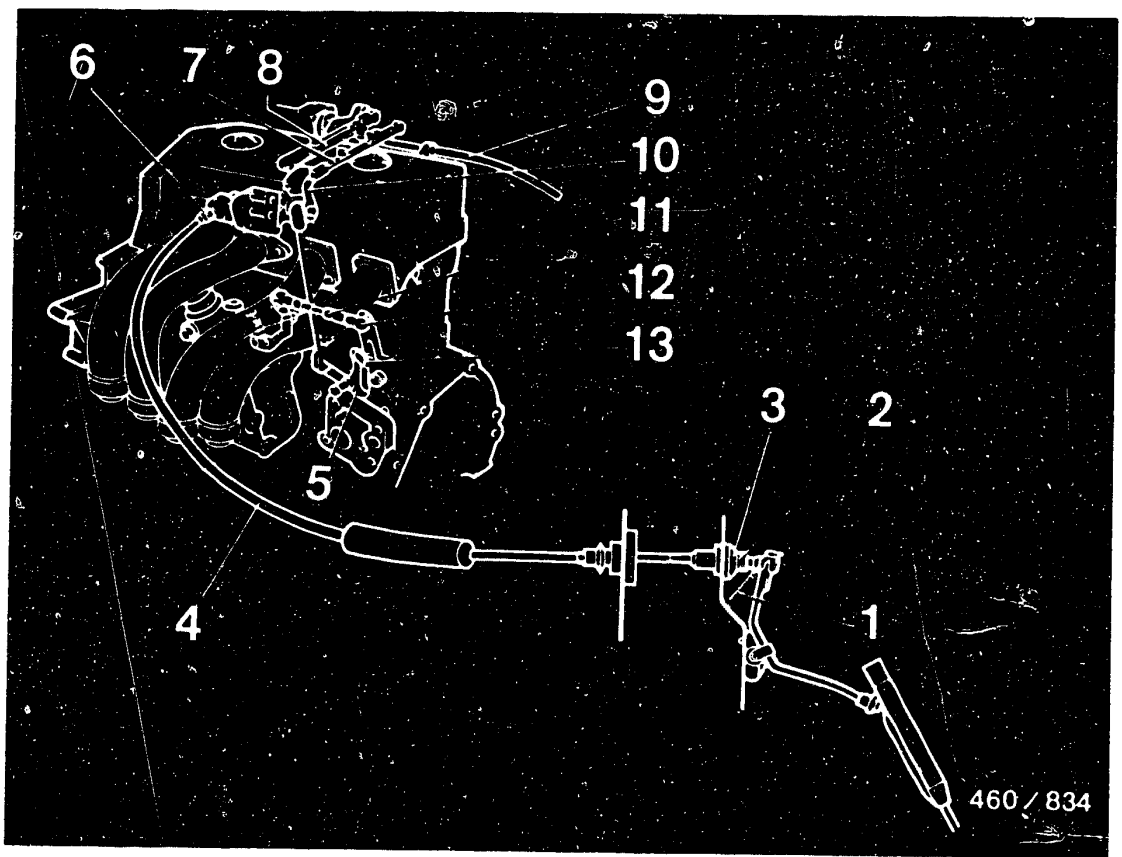




- 1 = Return spring
- 2 = Adjusting nut
- 3 = Rubber grommet
- 4 = Bowden cable
- 5 = Variable-fulcrum lever (automatic transmission only)
- 6 = Adjusting screw
- 7 = Idle travel rod
- 8 = Connecting rod
- 9 = Control pressure cable for automatic transmission
- 10 = Bell crank
- 11 = Connecting rod
- 12 = Ball head
- 13 = Roller

7. Set engine-speed regulation





The engine-speed regulation is set at the connecting rod (11).

Setting dimension from centre of ball head to centre of ball head = 146 ± 8 mm



8. Trouble-shooting

Customer complaint (fault symptom)

1. Engine fails to start or starts only with great difficulty when hot
2. Engine fails to start or starts only with great difficulty when cold
3. Engine hunts when idling
4. Rough idle with engine hot
5. Engine missing during vehicle operation (part load)
6. Unsatisfactory performance
7. Engine bucking under full load

							Cause	Coordinates
•	•			•	•		Tank empty; tank vent clogged	B 9
•	•	•	•	•	•		Injection sequence does not correspond to firing sequence	B 11
	•			•			Heavy paraffin deposits in filter	B 12
•	•		•	•	•	•	Air in fuel system	B 14
•	•		•	•	•	•	Connections loose; lines leaking or broken	B 14
•	•			•	•		Supply lines clogged	B 17
•	•		•	•			Injection lines clogged or constricted	B 17
					•	•	Engine air filter clogged	C 1
		•	•				Idle speed incorrect	C 2
	•						Test pneumatic idle increase	C 6
		•	•				Set engine regulation	C 20
•	•						Test vacuum system	D 7

B1

Trouble-shooting
Mercedes Benz 190 D



B2

Trouble-shooting
Mercedes Benz 190 D



1. Engine fails to start or starts only with great difficulty when hot
2. Engine fails to start or starts only with great difficulty when cold
3. Engine hunts when idling
4. Rough idle with engine hot
5. Engine missing during vehicle operation (part load)
6. Unsatisfactory performance
7. Engine bucking under full load

							Cause	Coordinates
●	●		●	●	●	●	Injection nozzle defective	D 10
●	●			●	●	●	Fuel filter clogged	D 23
●	●			●	●	●	Test fuel supply pump	E 1
●	●			●	●		Overflow valve clogged	D 23
	●						Preheating system defective	E 2
					●		Engine compression poor or uneven	E 22
●	●		●	●	●	●	Start of delivery incorrect	H 6
					●	●	Timing device defective	E 18
					●		Maximum engine speed incorrectly set	F 8
●	●	●	●	●	●	●	Injection pump (governor) defective or out of adjustment	F 8



8. Fuel consumption too high								
9. Engine will not stop or hesitates in stopping								
10. Rough engine running, black smoke in full-load range; lack of power								
11. Fog-like smoke in full-load range (white)								
12. Incorrect engine speeds								
13. Engine will not rev up when cold								
14. Injection pump overheating								
Cause								Coordinates
			●		●			Tank empty; tank vent clogged B 9
		●	●		●			Injection sequence does not correspond to firing sequence B 11
						●		Heavy paraffin deposits in filter B 12
			●		●			Air in fuel system B 14
●		●	●		●			Connections loose; lines leaking or broken B 14
						●		Supply lines clogged B 17
		●						Injection lines clogged or constricted B 17
●		●						Engine air filter clogged C 1
				●				Idle speed incorrect C 2
				●				Test pneumatic idle increase C 6
				●				Set engine regulation C 20
	●							Test vacuum system D 7



8. Fuel consumption too high

9. Engine will not stop or hesitates in stopping

10. Rough engine running, black smoke in full-load range; lack of power

11. Fog-like smoke in full-load range (white)

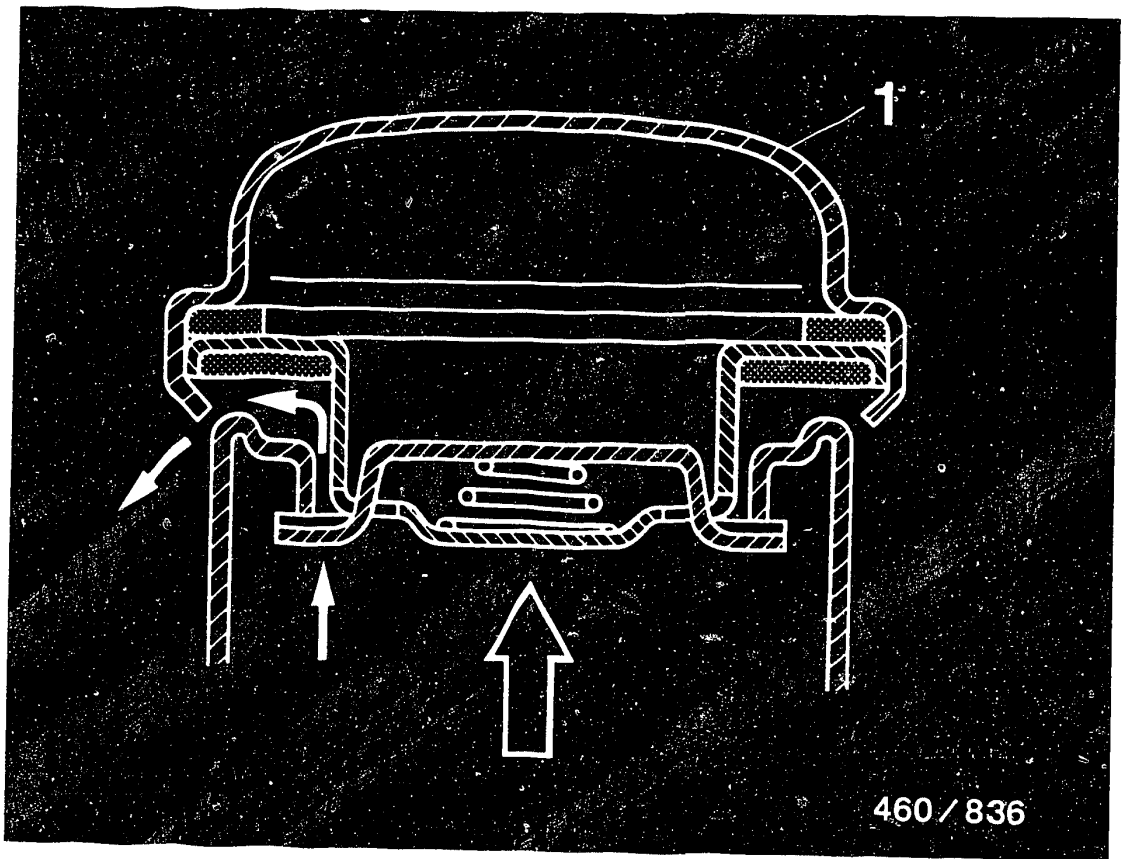
12. Incorrect engine speed

13. Engine will not rev up when cold

14. Injection pump overheating

Cause							Coordinates
●		●	●			●	D 10
			●		●		D 23
	●						E 1
					●		D 23
	●						E 2
		●	●				E 22
●		●	●		●		H 6
●		●	●		●		E 18
				●			F 8
●	●	●	●	●	●	●	F 8





9. Check tank vent

Remove fuel filler cap.

If customer complaint disappears after removing filler cap, test ventilation system (filler cap and ventilation valve).

Note:

At 100 - 300 mbar gauge pressure, the fuel evaporation gases can escape through the filler cap (1).

B9

Check tank vent

Mercedes Benz 190 D



Test ventilation line of ventilation valve for clogging.

Ventilation line runs from central pipe downward through the fuel tank.

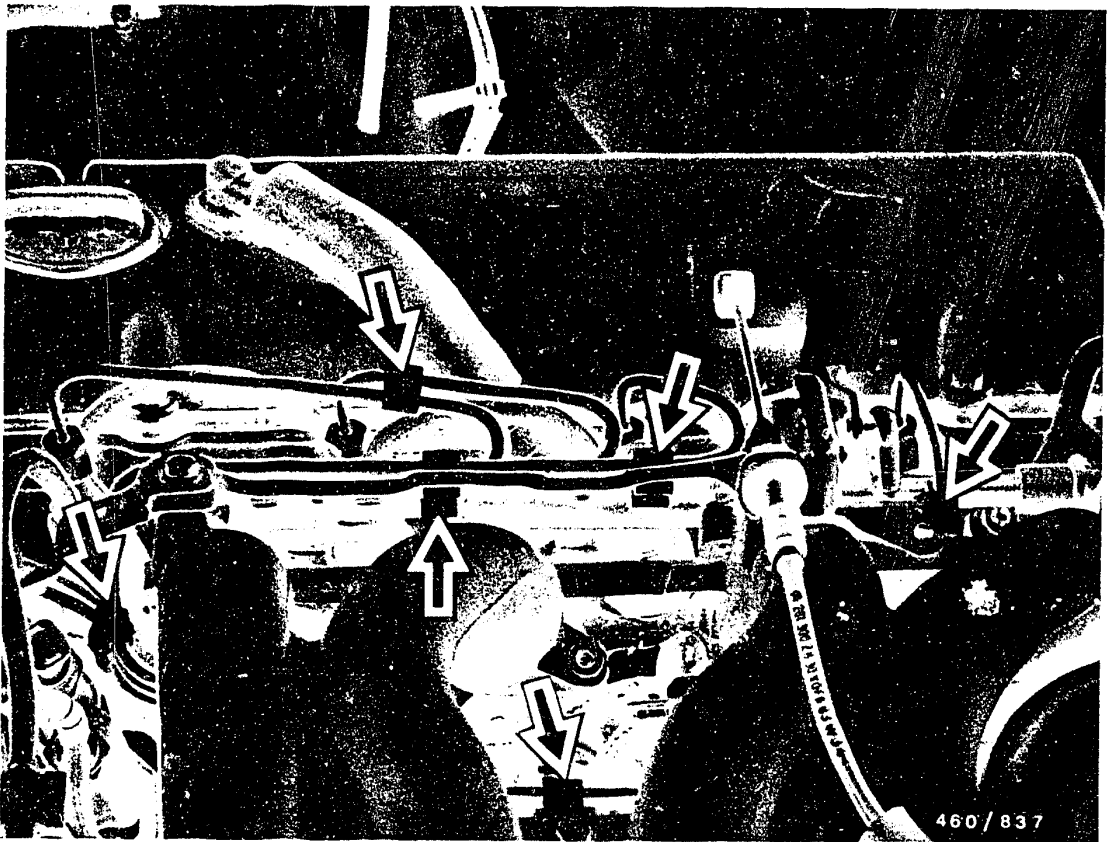
The ventilation valve is connected to the end of the ventilation line.

B 10

Check tank vent

Mercedes Benz 190 D





10. Check routing of fuel-injection tubing

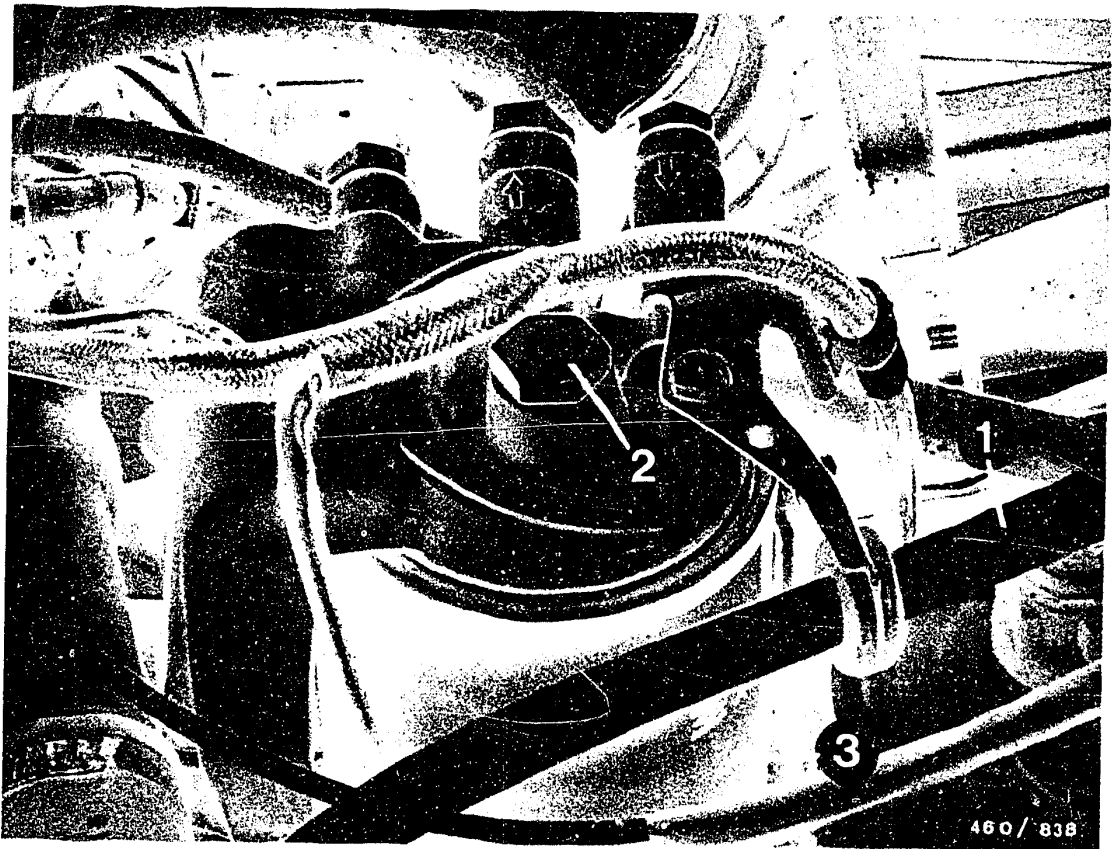
The fuel-injection lines are connected together by means of plastic clips (see picture, arrows) so that it is impossible to mix up the outlets.

If, nevertheless, there is doubt, check the routing of the lines according to the above picture.

B11

Check routing of fuel-injection tubing
Mercedes Benz 190 D



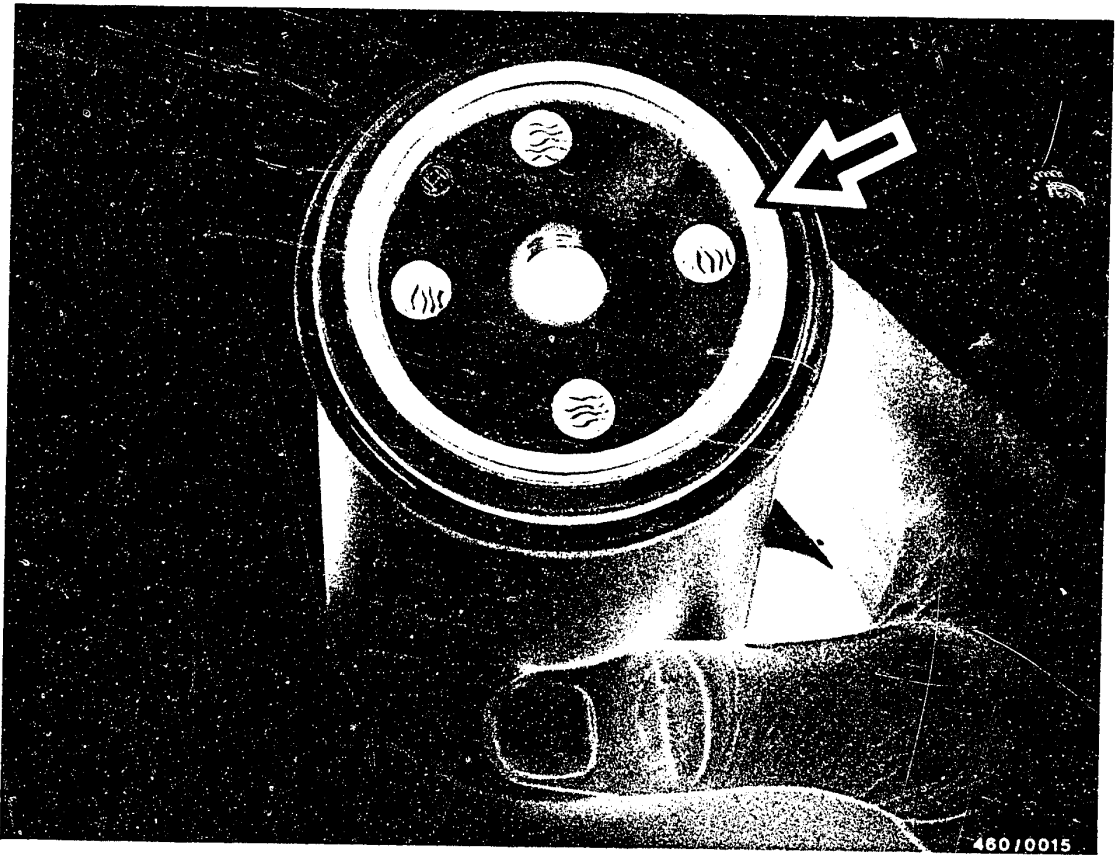


11. Renew filter box

Unhook vacuum line (1).

Loosen fastening screw (2) and remove filter (3) downward.





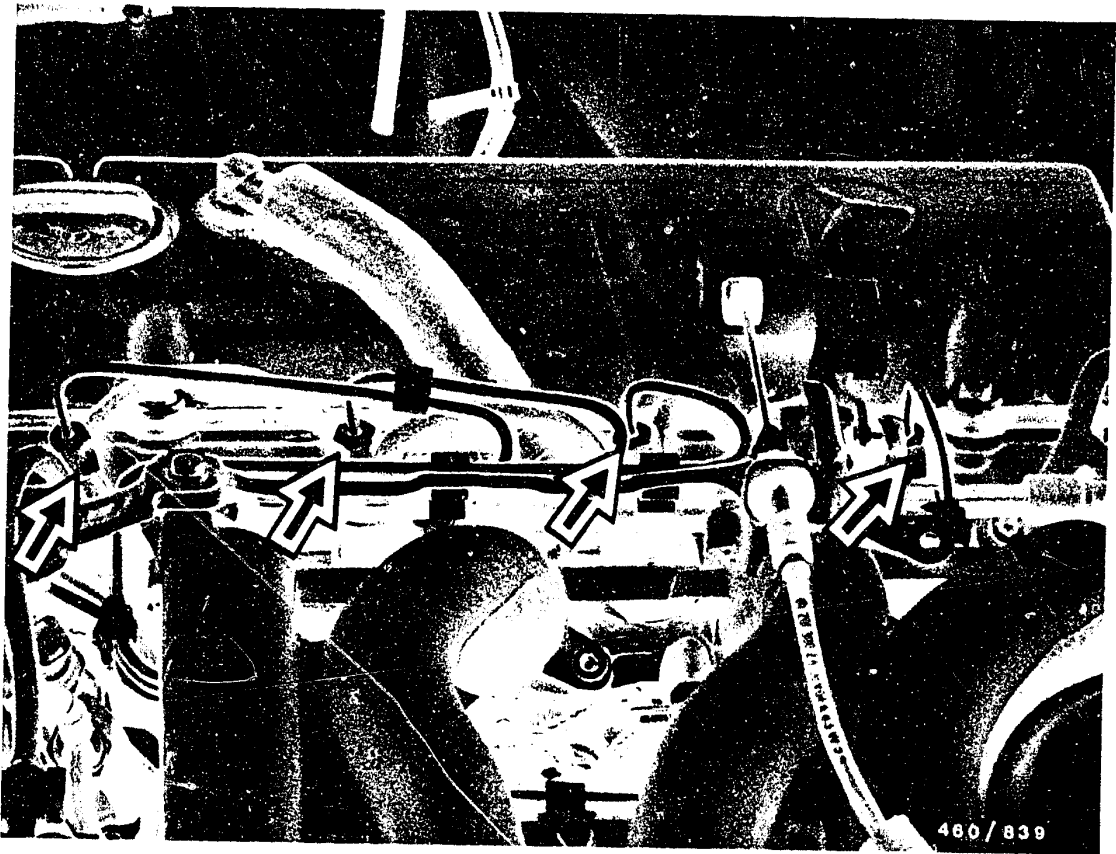
Rub diesel fuel into rubber seal (arrow) of new filter box.

Screw filter box by hand into the cover and tighten.
Test fuel filter for leaks (visual examination).

B 13

Renew filter box
Mercedes Benz 190 D





12. Test fuel-injection system for leaks

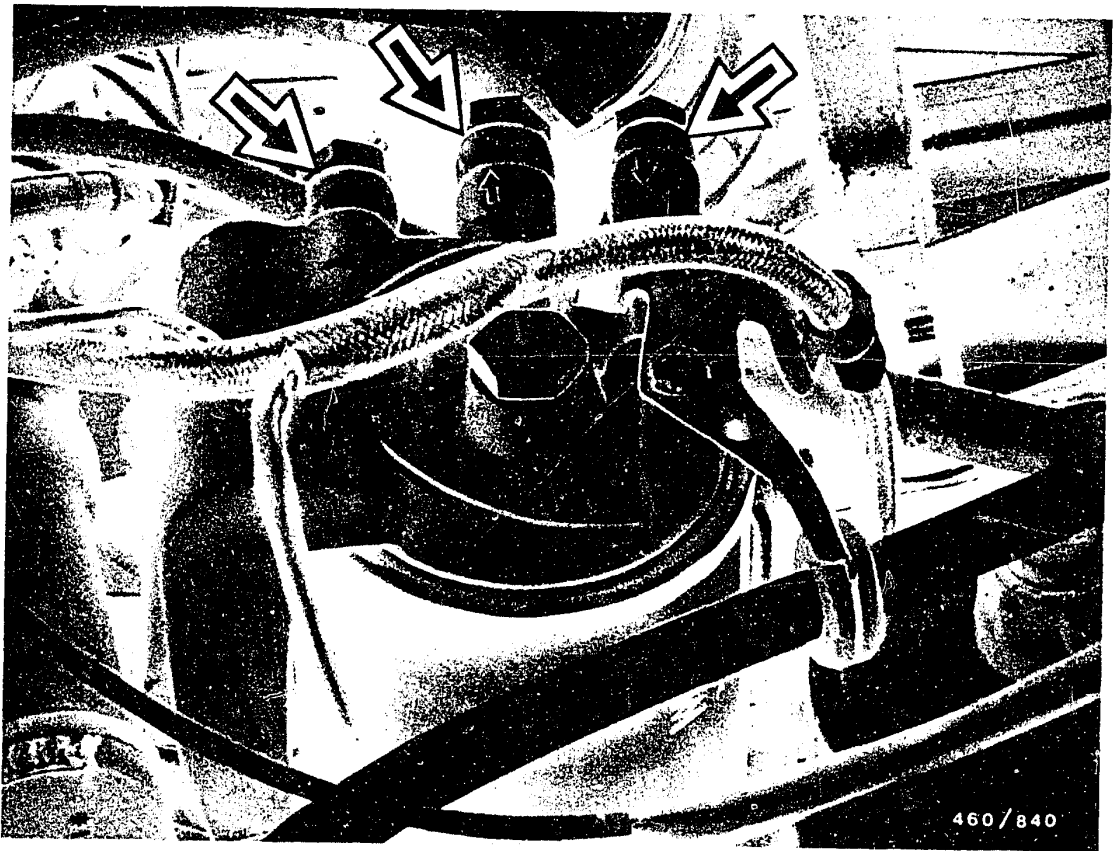
Leak test to be performed with engine at normal operating temperature.

Visually examine all connection points of fuel lines.

Pay particular attention to:

- connections of nozzle-holder assemblies (see picture, arrows).



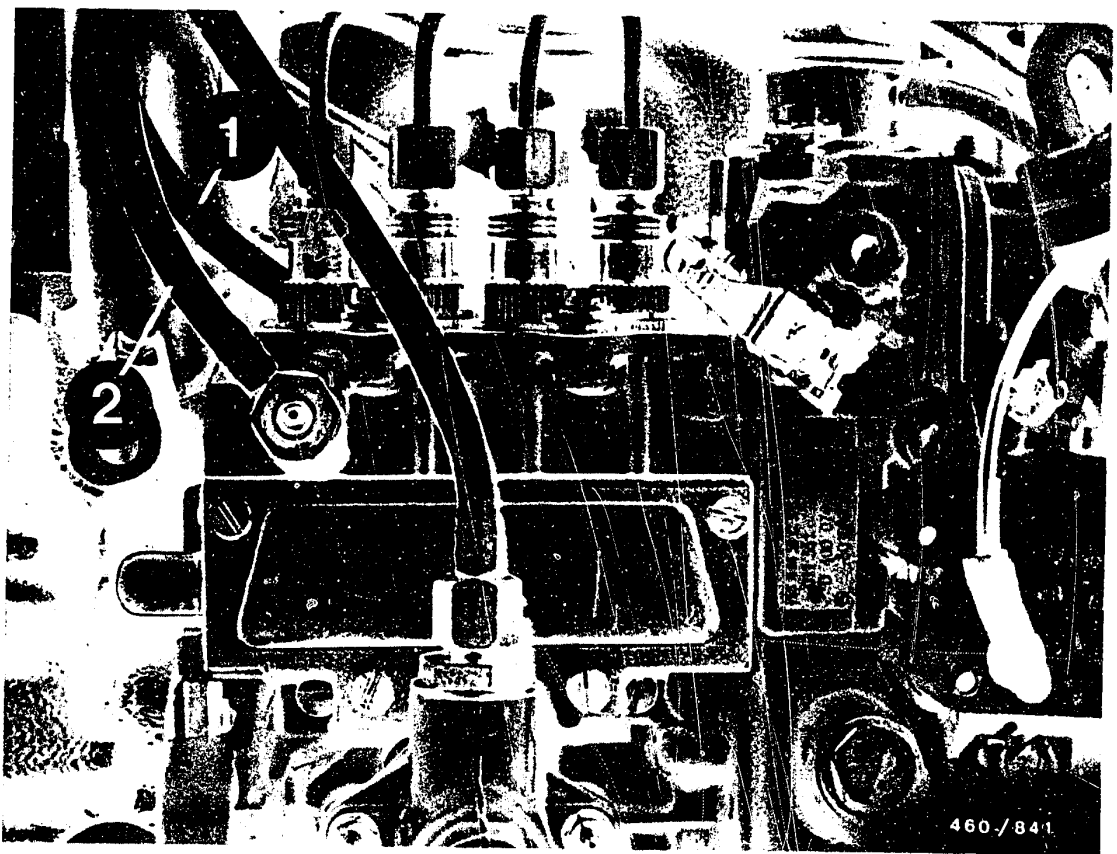


- Connections on fuel filter (see picture, arrows).

B 15

Test fuel-injection system for leaks
Mercedes Benz 190 D

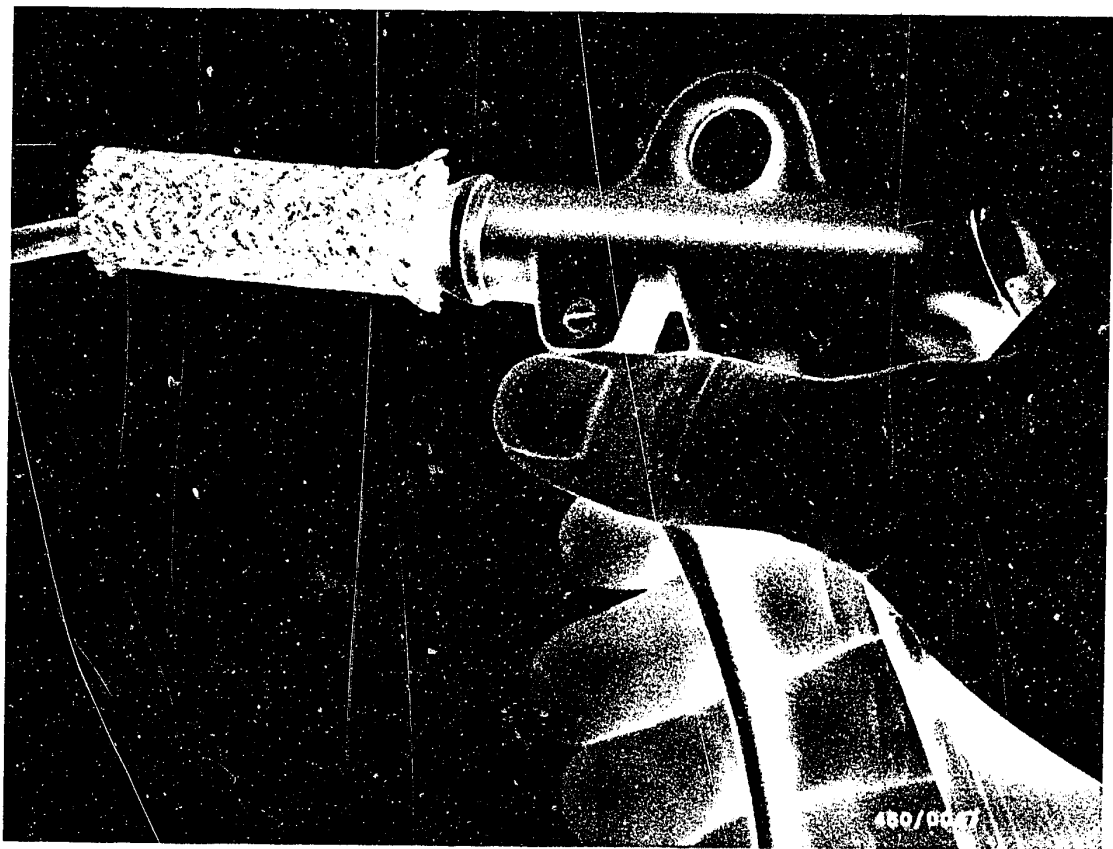




1 = Fuel inlet line
2 = Fuel return line

- Delivery-valve holders on the individual outlets
- Hairline cracks on fuel lines
- Inlet line and return line on injection pump





13. Test fuel lines

Perform visual examination of suspect fuel lines.

If crushing or kinking is detectable, remove the fuel line in question.

Test fuel line for throughflow with compressed air and clean if necessary.

For blowing through the fuel lines, it is possible to use a suitable piece of hose to seal off the line at the sides.



14. Smoke test - check air filter

14.1 Smoke test

Summary of the contents of the legal regulations (as at April 1978). Applicable to the Federal Republic of Germany.

This regulation applies only to the homologation of motor vehicles having at least 4 wheels with a maximum permissible speed of more than 25 km/h. A smoke emission test is not prescribed for official general inspections.

Parts which may have an influence on environmental pollution must be designed in such a way that the legal requirements are met during operation and despite vehicle vibration.

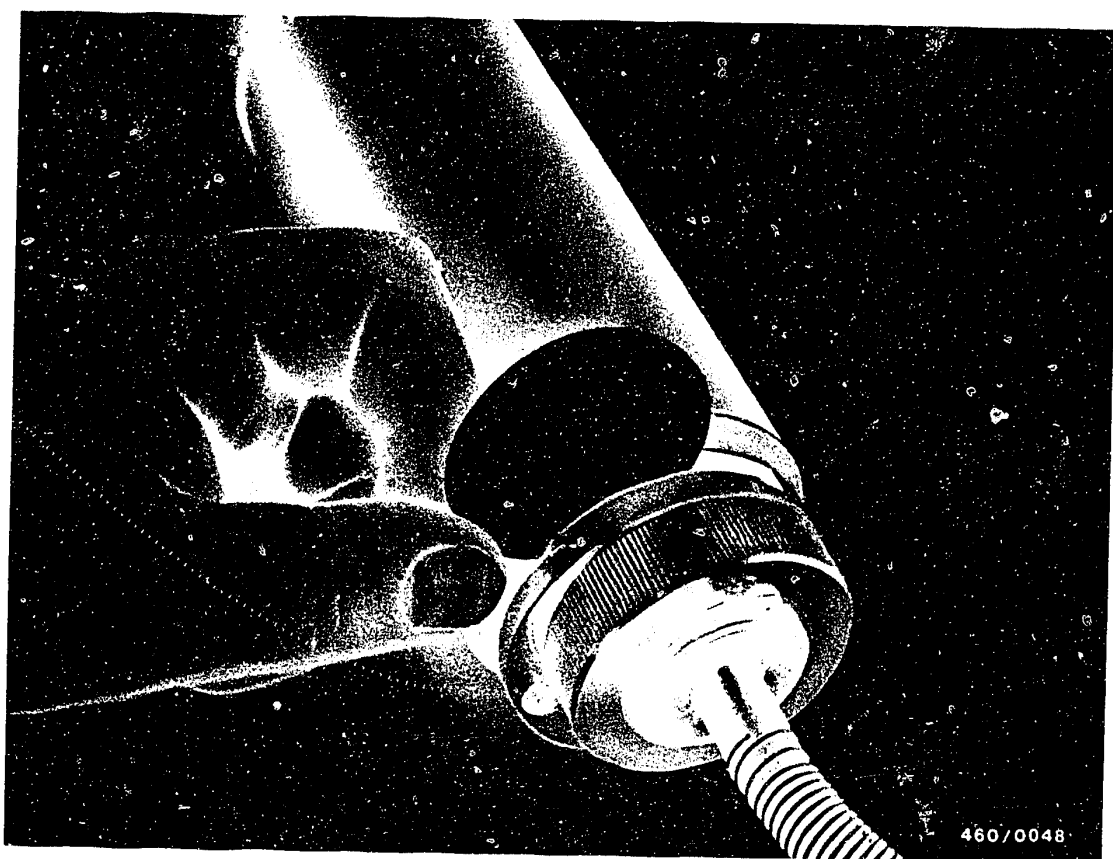
This applies in particular to cold-start devices and full-load stops. The Rheinland-Westfälische TÜV (Technical Inspection Bureau of Rhineland-Westfaila) in Essen is the sole approval agency.

B 18

Smoke test

Mercedes Benz 190 D





14.1.1 Test setup

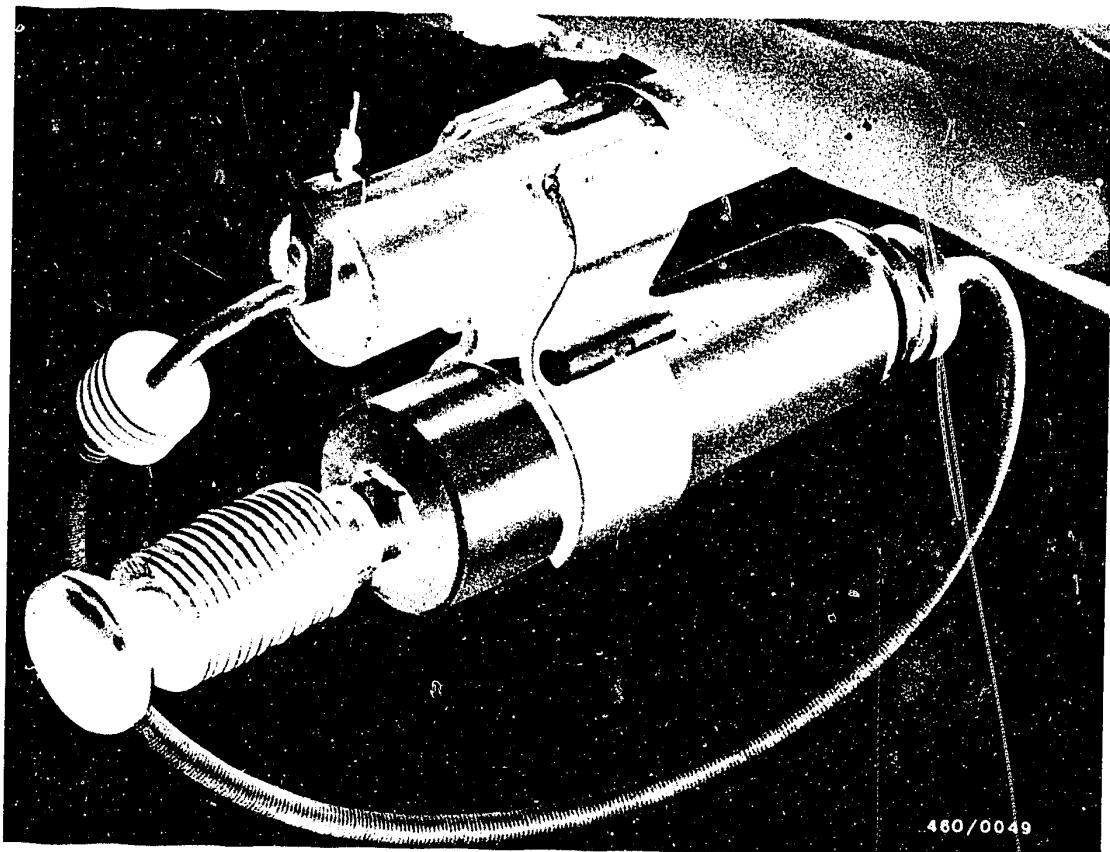
The smoke test is conducted using the BOSCH smokemeter.
The smokemeter consists of the following units:

Accessories box with proportioning pump 0 681 169 038

Evaluating unit 0 684 102 050

Insert filter plate into proportioning pump.





Mount sampling pump on exhaust pipe using appropriate clamp.

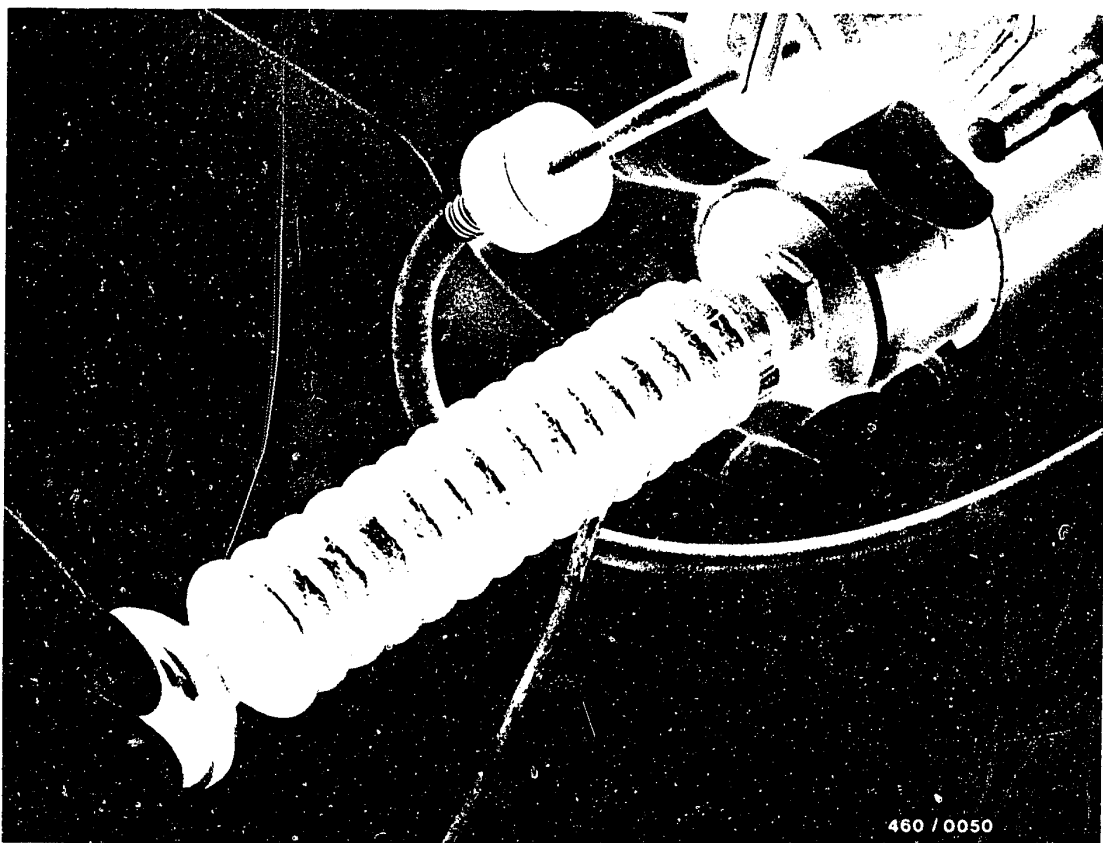
Introduce exhaust-sample pickup as far as possible into exhaust pipe and clamp in position.

B20

Smoke test

Mercedes Benz 190 D





14.1.2 Test procedure

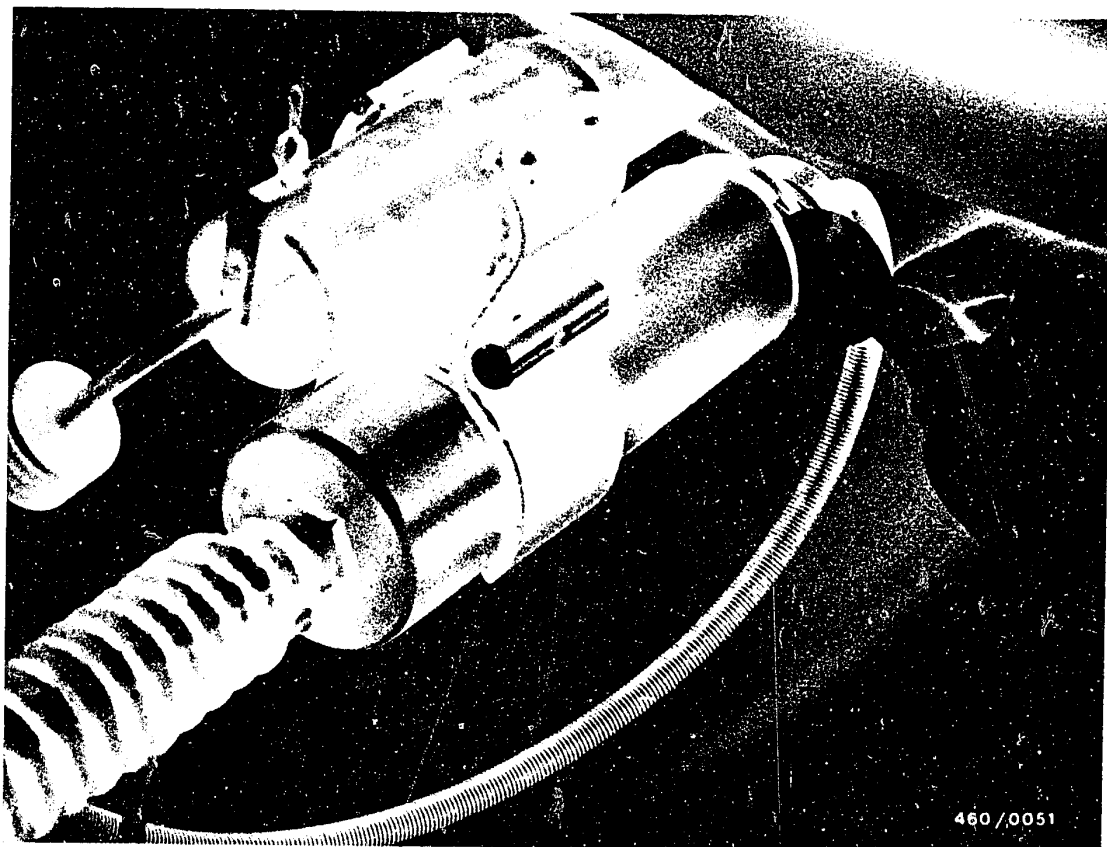
Set proportioning pump by pressing in the black push-button. Take rubber ball on triggering hose and enter passenger compartment.

The test can be performed on the chassis dynamometer or on the road (gradient). (The chassis dynamometer is preferable).

Select any gear and "drive flat out". Establish the maximum possible speed. With the accelerator in the same position, load the engine by 40% so that 60% of the maximum speed is reached. Maintain this load condition for 5 seconds and then trigger the sampling pump by pressing the rubber ball.

Switch off engine.

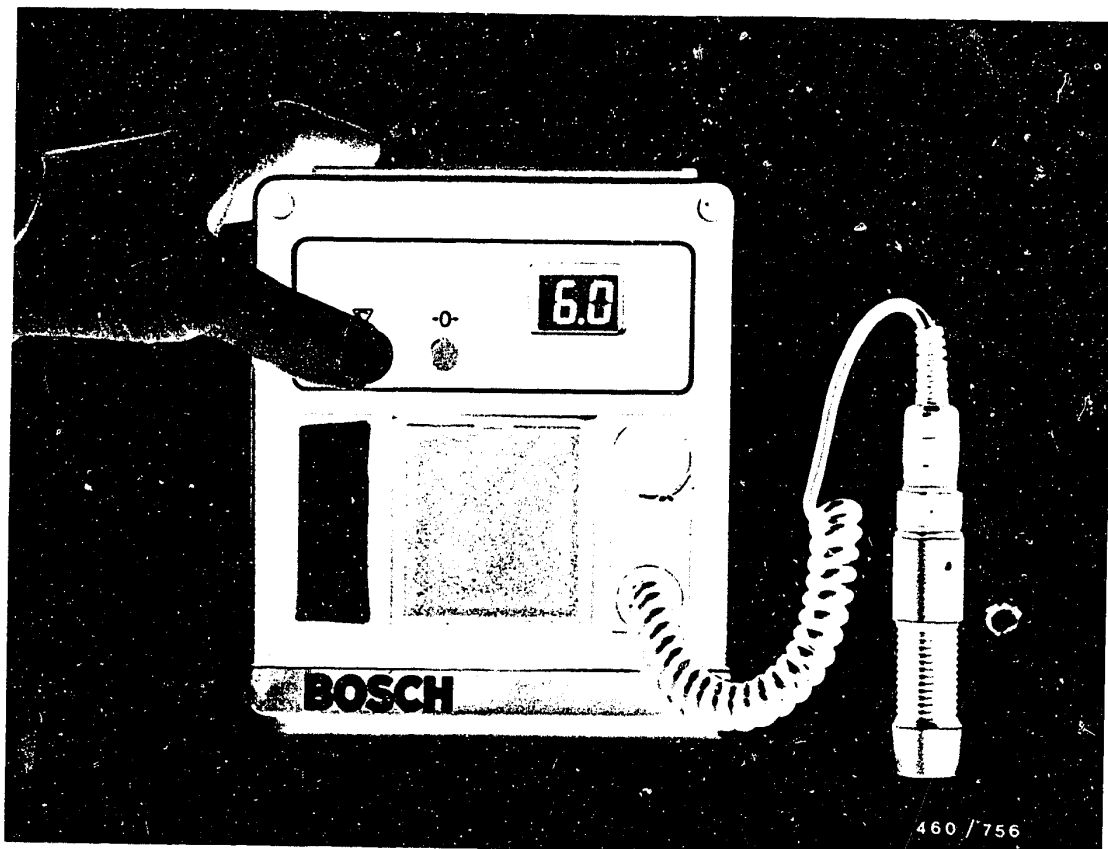




Caution

During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

Remove filter plate from sampling pump.



Setting the zero point

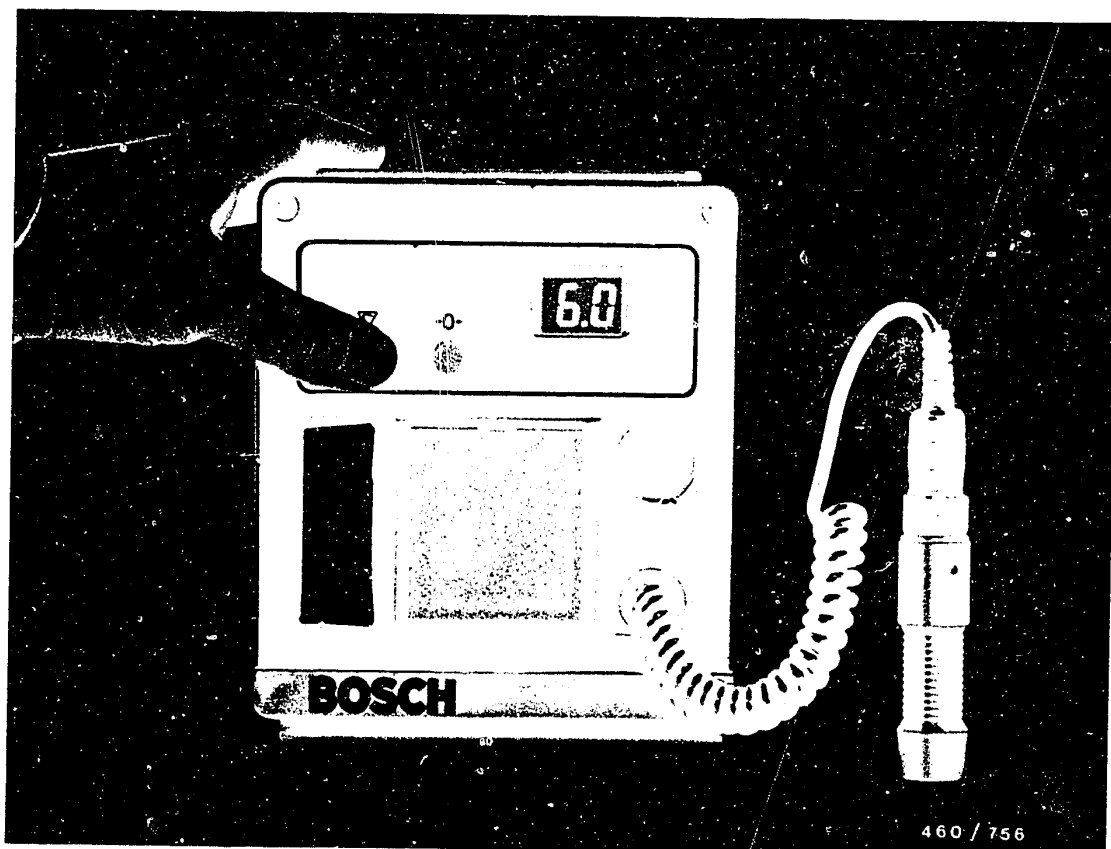
The zero point adjustment must be performed

- before each series of measurements
- in case of changes in ambient conditions
- whenever the lens of the photoelement adapter has been cleaned.

Firmly press measuring head of photoelement adapter onto 5 clean white filter plates placed one on top of the other.

Press button "0" until display 0.0 appears.
Release button "0".





Measuring

Place filter plate from sampling pump - with sooted side to the top - on 3 new filter plates placed one on top of the other.

Press measuring head vertically onto black surface of filter plate, simultaneously pressing button "C" until the measured smoke number appears on the display.

Note:

Measuring head must be firmly pressed down both for the zero point adjustment as well as when measuring (even slight tilting can lead to incorrect measurements).

Compare smoke number with evaluation sheet.

Note kW (hp-din) data of vehicle manufacturer.



14.2 Check air filter

Remove air filter and subject to a visual inspection.

Test criteria for air filter:

- dusty air filter
- oiled-up air filter
- solid matter in air filter, e.g. leaves

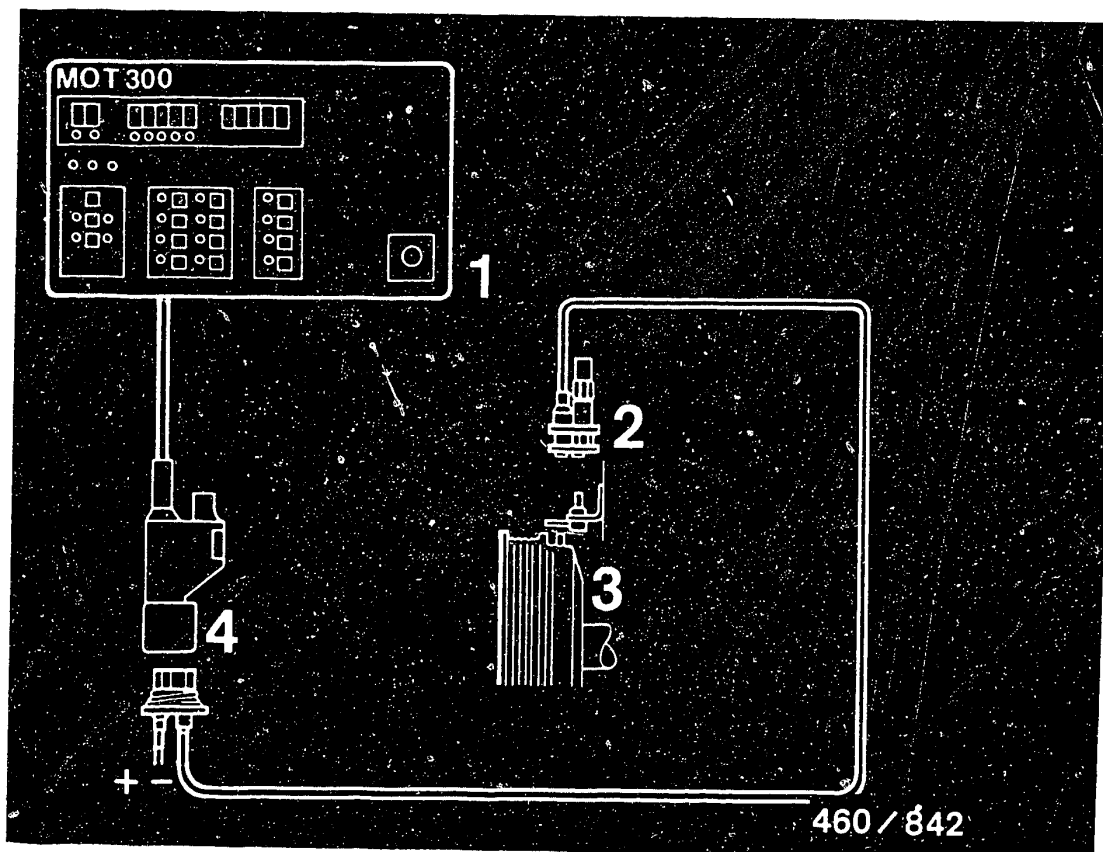
If in doubt, use new filter element.

C1

Smoke test - check air filter

Mercedes Benz 190 D





- 1 = Motortester
- 2 = TDC pickup
- 3 = Pulley on crankshaft
- 4 = Adapter lead

15. Test and adjust idle speed with motortester or diesel engine tester

Necessary test equipment:

TDC pickup for engine 601 Daimler Benz part no.:
601 589 042 100 (if necessary, procure through DB branch).

Adapter lead for motortester (e.g. MOT 300)

1 684 463 094

Adapter lead for diesel engine tester (ETD 019):

1 684 463 147



Test the mechanics of the engine-speed regulation for freedom of movement and wear.

For adjusting the idle speed, the engine must be at normal operating temperature (coolant temperature 60°C - 80°C).

Note:

If a TDC pickup is not available, establish engine speed using commercially available tachometer (e.g. photo-electric).

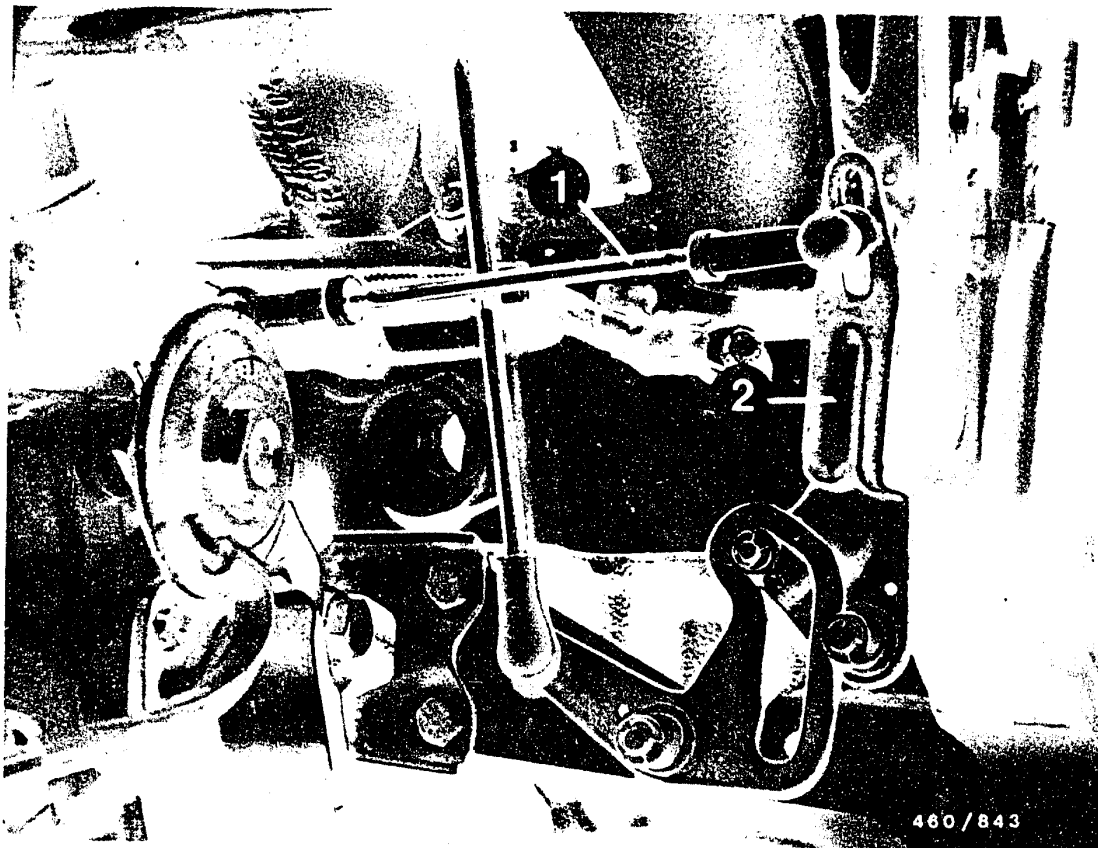
To do this, attach reflecting mark on crankshaft. Aim digital manual tachometer at reflecting mark and sense engine speed optically.

C3

Adjust idle speed

Mercedes Benz 190 D





- 1 = Connecting rod
- 2 = Deflection lever

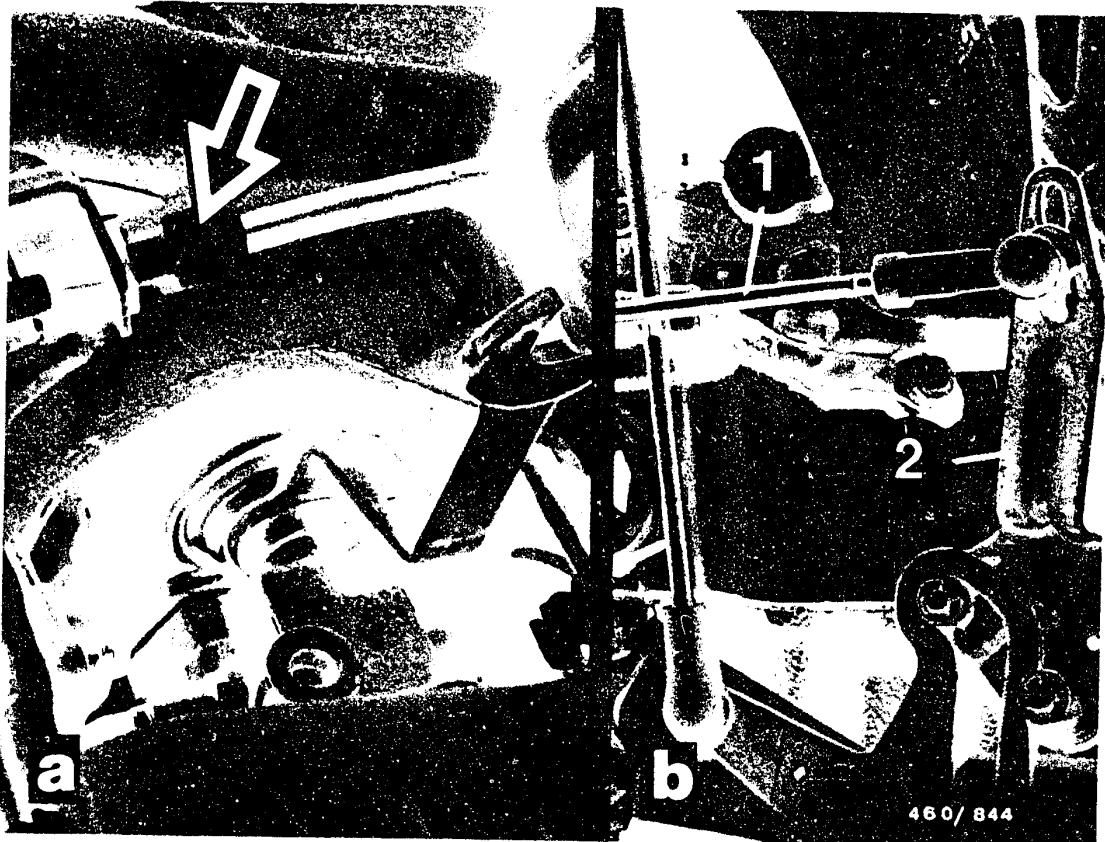
Unhook connecting rod on deflection lever.

C4

Adjust idle speed

Mercedes Benz 190 D





Test idle speed (should be 700 - 800 min⁻¹)
 If correction is necessary, proceed as follows:

Loosen vacuum unit lock nut (see picture a)
 and adjust idle speed by turning the vacuum unit.

Hook connecting rod (1) into deflection lever (2) so
 that it is free of tension. Setting dimension from
 centre of ball head to centre of ball head = 146 ± 8 mm.

Switch on all electrical auxiliary units and check
 whether engine still idles smoothly.

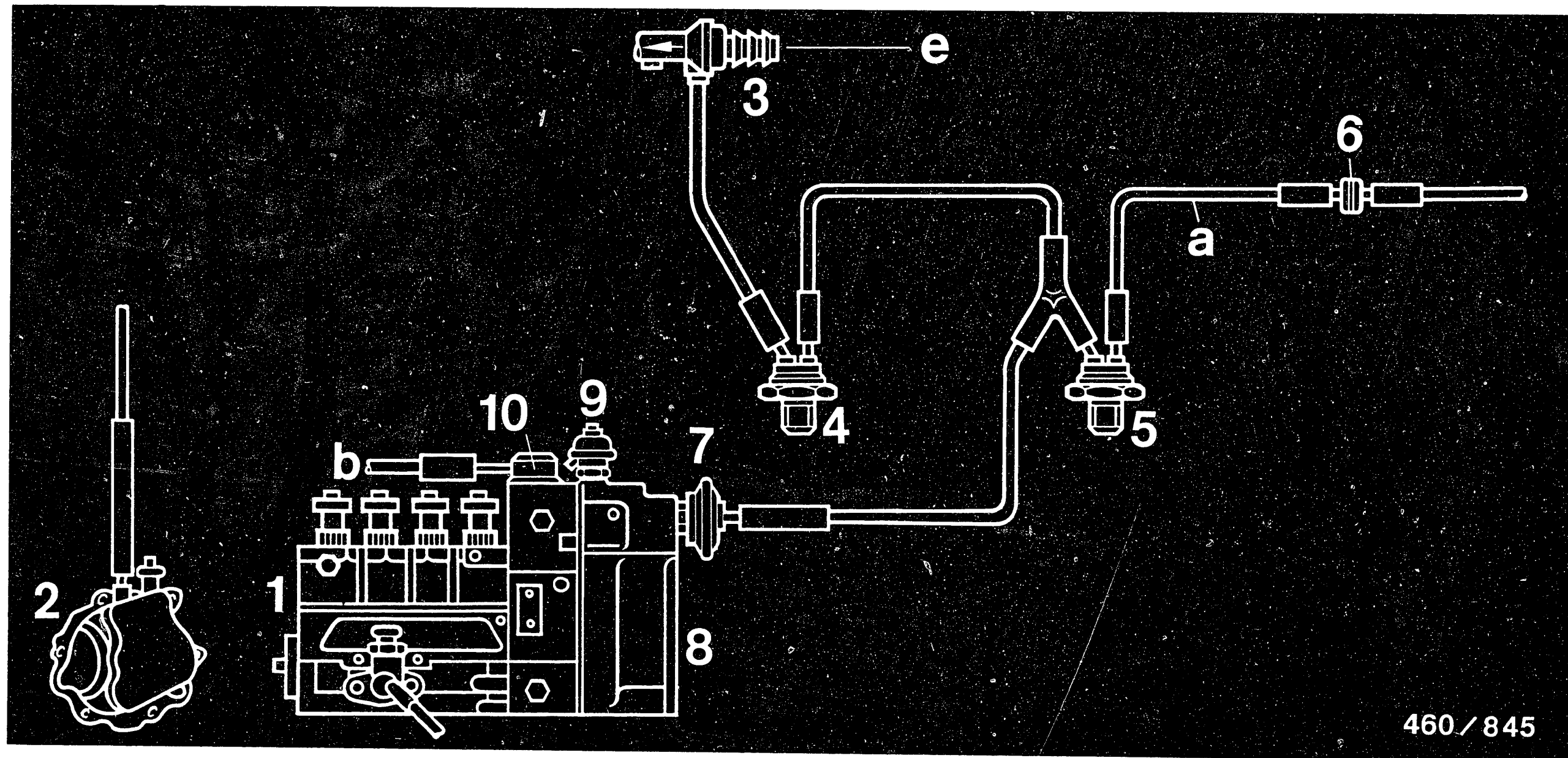
If necessary, adjust at cable adjusting screw (see
 arrow, picture a).

C5

Adjust idle speed

Mercedes Benz 190 D





460/845

- 1 = Injection pump
- 2 = Vacuum pump
- 3 = Brake assembly non-return valve
- 4 = Thermo-valve
- 5 = Thermo-valve

- 6 = Air filter
- 7 = Idle increase vacuum unit
- 8 = Governor
- 9 = ADA (altitude-pressure compensator) unit
(USA only)
- 10 = Vacuum unit (shutoff box)

- a = Air line to passenger compartment
- b = to key-operated shutoff
- e = to brake assembly

16. Test pneumatic idle increase

Before performing this operation, test idle speed and, if necessary, adjust to $700 \dots 800 \text{ min}^{-1}$ by turning the vacuum unit.

16.1 Functional diagram of idle increase for vehicles with mechanical transmission

C6

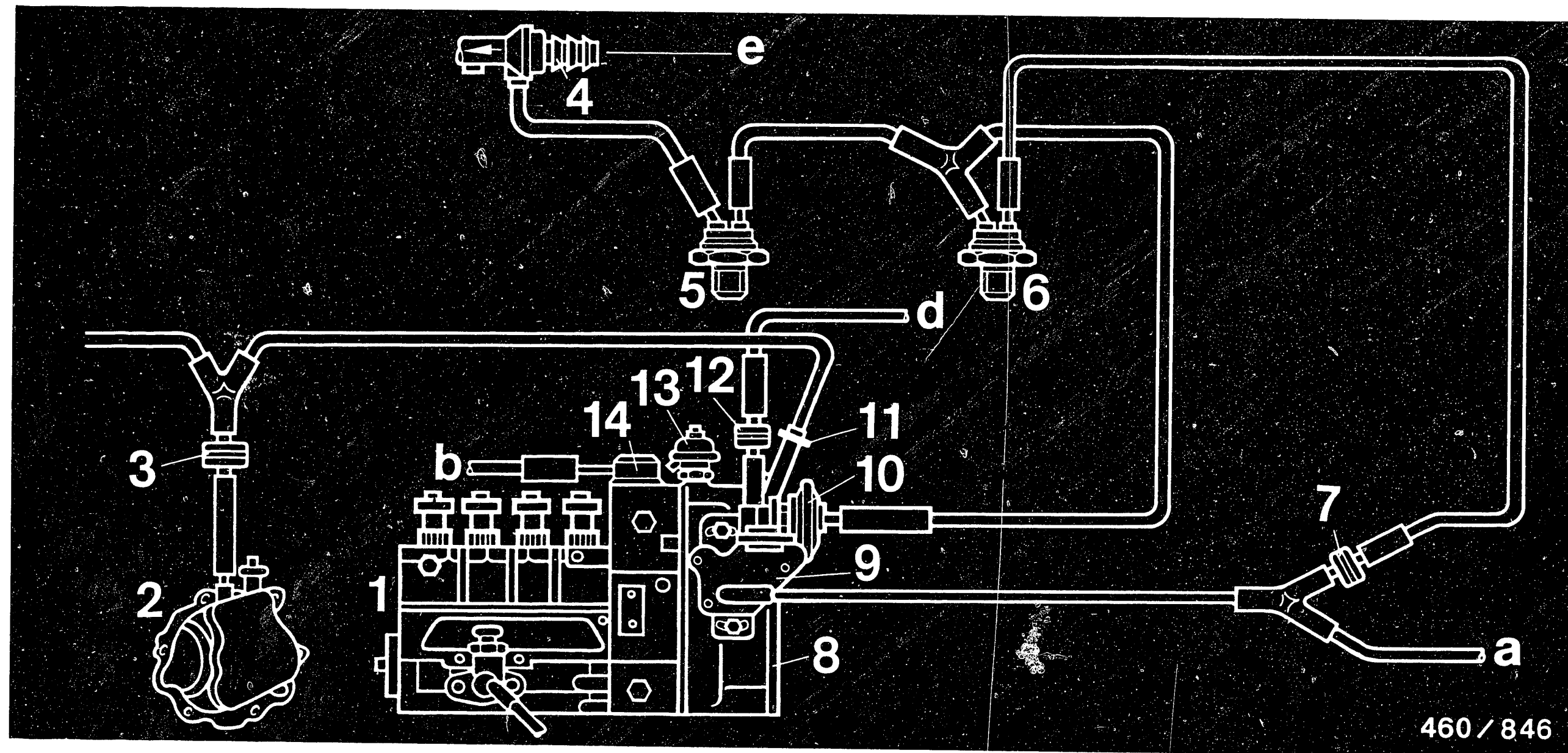
Test pneumatic idle increase
Mercedes Benz 190 D



C7

Test pneumatic idle increase
Mercedes Benz 190 D





460 / 846

- 1 = Injection pump
- 2 = Vacuum pump
- 3 = Air filter
- 4 = Non-return valve
- 5 = Thermo-valve
- 6 = Thermo-valve
- 7 = Air filter

- 8 = Governor
- 9 = Vacuum-control valve
- 10 = Idle increase vacuum unit
- 11 = Restriction
- 12 = Damper
- 13 = ADA (altitude-pressure compensator) unit (USA only)
- 14 = Vacuum unit (shutoff box)

- a = Air line to passenger compartment
- b = to key-operated shutoff
- d = to automatic transmission vacuum unit
- e = to brake assembly

16.2 Functional diagram of idle increase for vehicles with automatic transmission

C8

Test pneumatic idle increase

Mercedes Benz 190 D

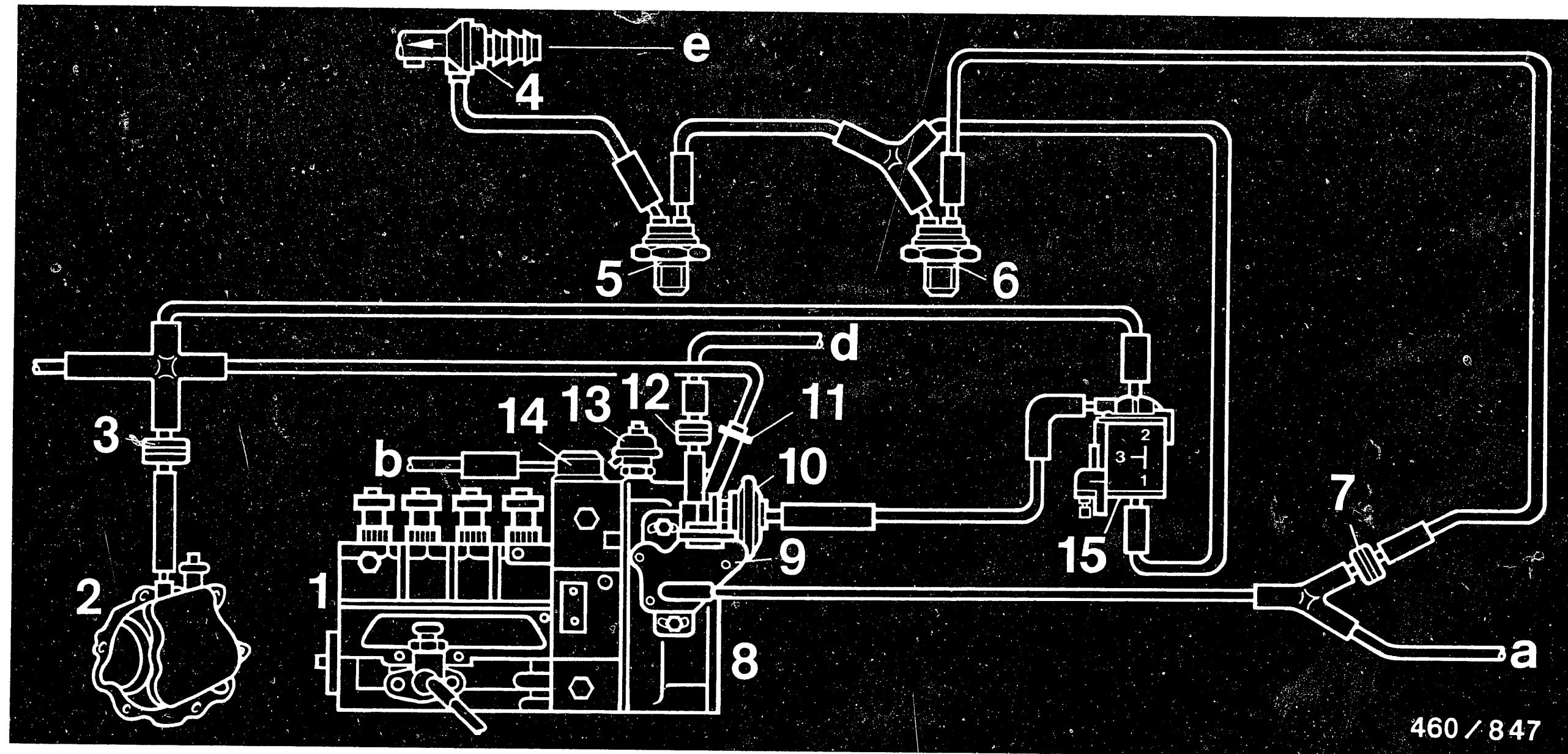


C9

Test pneumatic idle increase

Mercedes Benz 190. D





460 / 847

- 1 = Injection pump
- 2 = Vacuum pump
- 3 = Air filter
- 4 = Non-return valve
- 5 = Thermo-valve
- 6 = Thermo-valve
- 7 = Air filter

- 8 = Governor
- 9 = Vacuum-control valve
- 10 = Idle increase vacuum unit
- 11 = Restriction
- 12 = Damper
- 13 = ADA (altitude-pressure compensator) unit (USA only)
- 14 = Vacuum unit
- 15 = Change-over valve (only in conjunction with air conditioner)

- a = Air line to passenger compartment
- b = to key-operated shutoff
- d = to automatic transmission vacuum
- e = to brake assembly

16.3 Functional diagram of idle increase for vehicles with automatic transmission (USA, excluding California version, with air conditioner)

C10

Test pneumatic idle increase
Mercedes Benz 190 D



C11

Test pneumatic idle increase
Mercedes Benz 190 D



16.4 Functional description of pneumatic idle increase

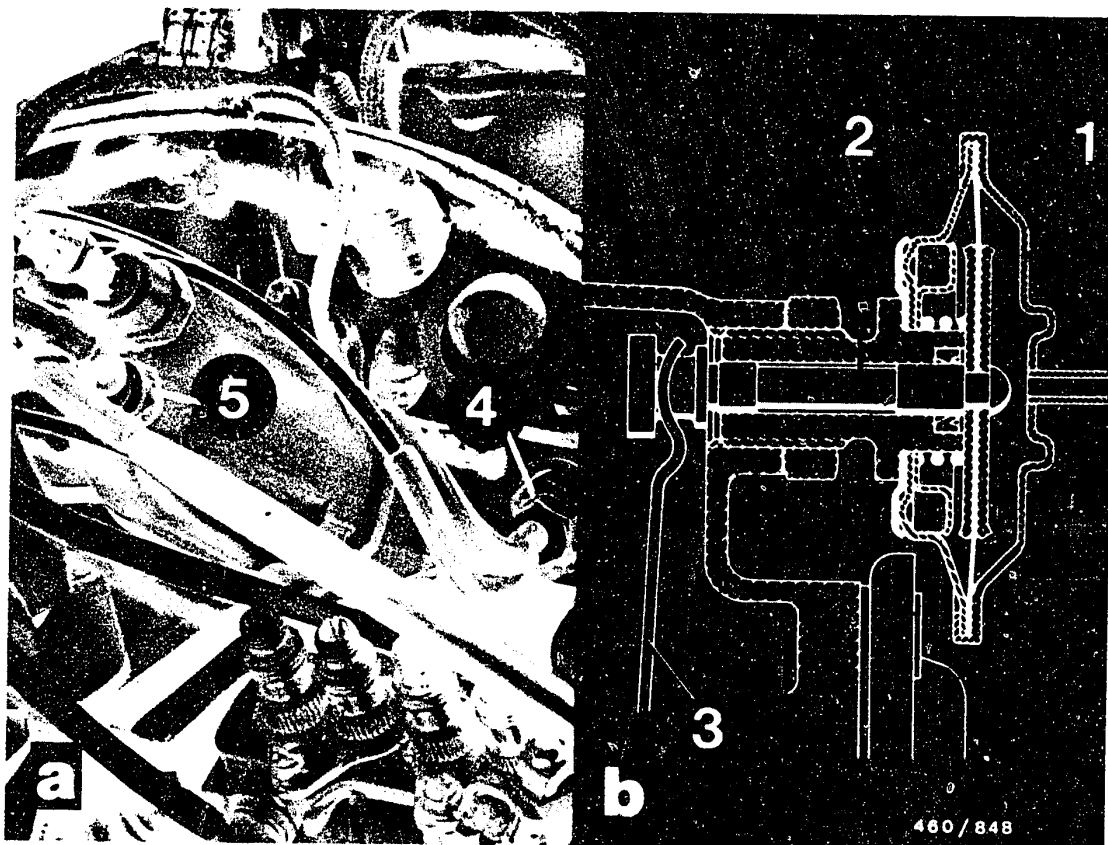
The idle increase for engine-speed stabilization is operative up to approx. +17°C coolant temperature (in vehicles with automatic transmission also above +17°C coolant temperature when refrigerant compressor is switched on).

C12

Test pneumatic idle increase

Mercedes Benz 190 D





The vacuum unit (1) on the governor housing is actuated through the thermo-valves (4 and 5) and, on USA vehicles excluding California version, also through the change-over valve (15 not shown).

If vacuum (approx. 500 mbar) is applied to the vacuum unit (1), the idle spring (3) is drawn in by a push rod (2).

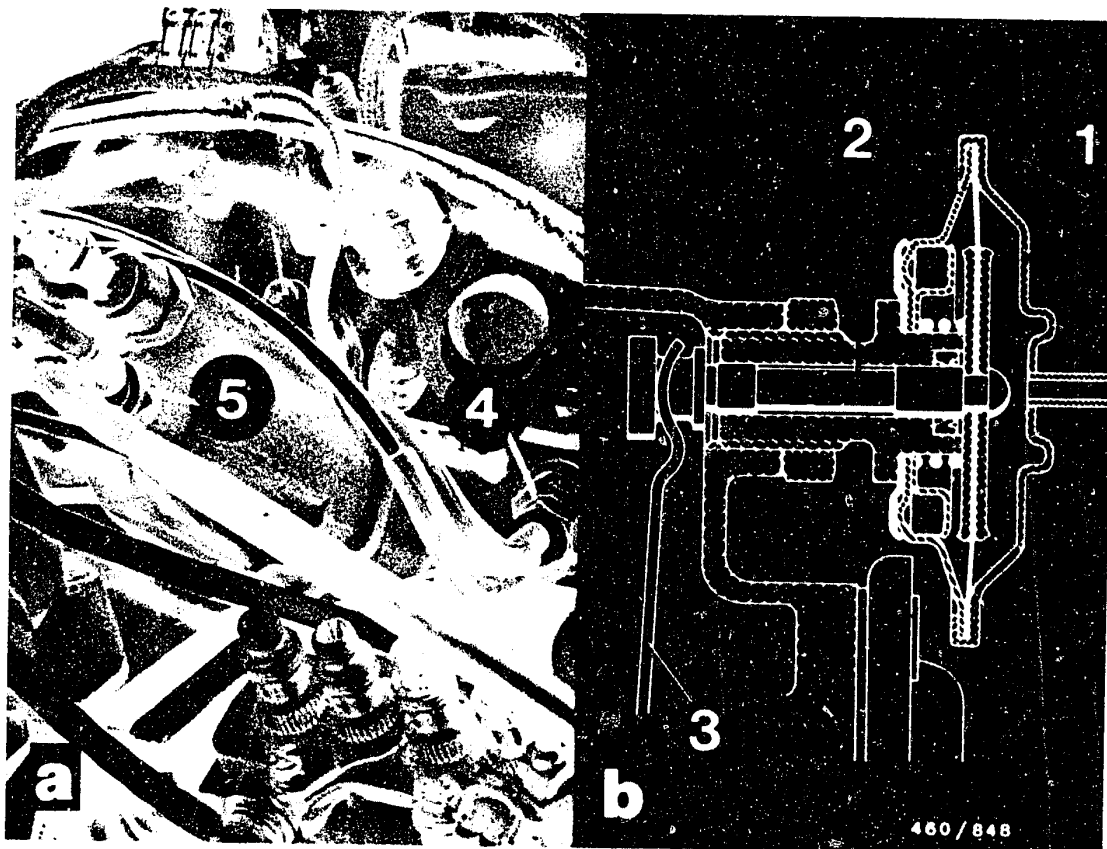
This shifts the idle characteristic, i.e. the idle speed is raised by approx. 100 min^{-1} .

C13

Test pneumatic idle increase

Mercedes Benz 190 D





At coolant temperatures below approx. $+17^{\circ}\text{C}$ the thermo-valve (4) is open, and the thermo-valve (5) is closed. Thus, vacuum is applied to vacuum unit (1). The idle speed is raised.

Note:

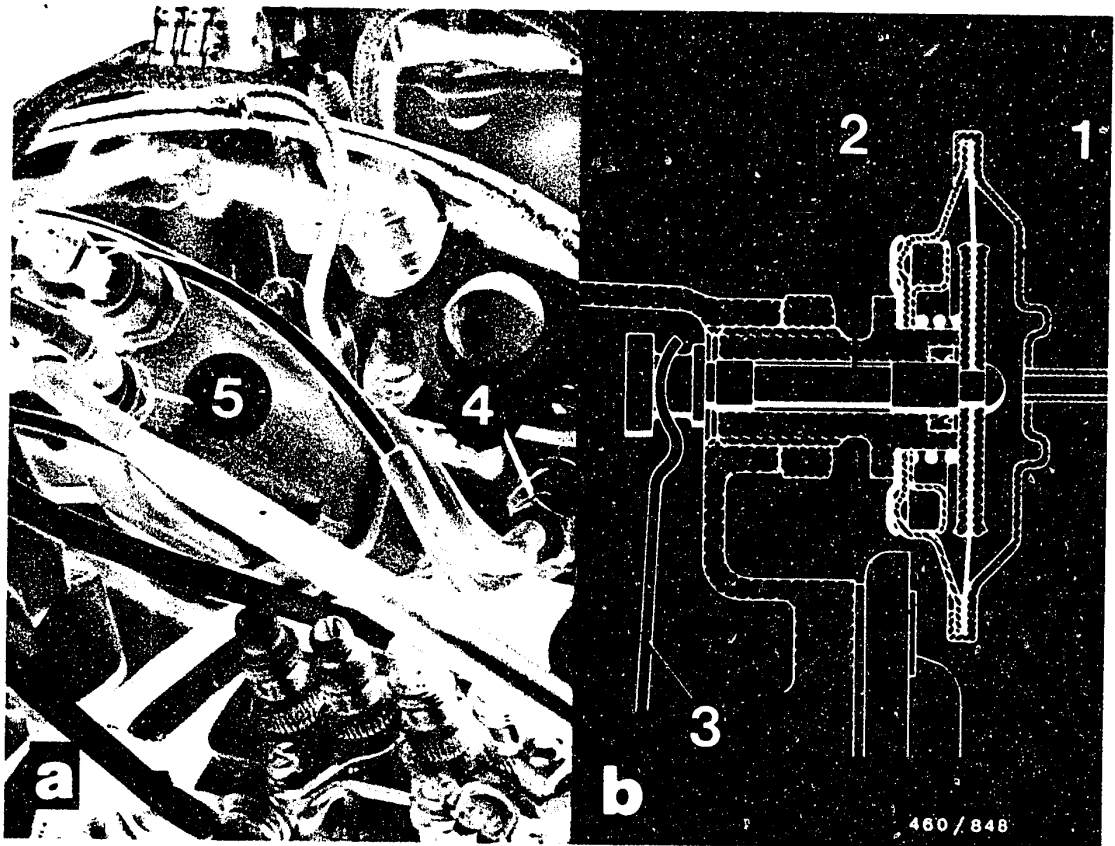
On USA vehicles (excluding California version) with automatic transmission and air conditioner, a change-over valve is connected before the vacuum unit.

C14

Test pneumatic idle increase

Mercedes Benz 190 D





At coolant temperatures above approx. $+17^{\circ}\text{C}$ the thermo-valve (4) is closed, and the thermo-valve (5) is open. Atmospheric pressure is applied to the vacuum unit (1) and the engine-speed increase is cancelled.

Note:

USA vehicles excluding California version with automatic transmission and air conditioner:

When the refrigerant compressor is switched on, the change-over valve is energized and connects vacuum to the vacuum unit through connections 2 and 3.

C15

Test pneumatic idle increase

Mercedes Benz 190 D



16.5 Testing

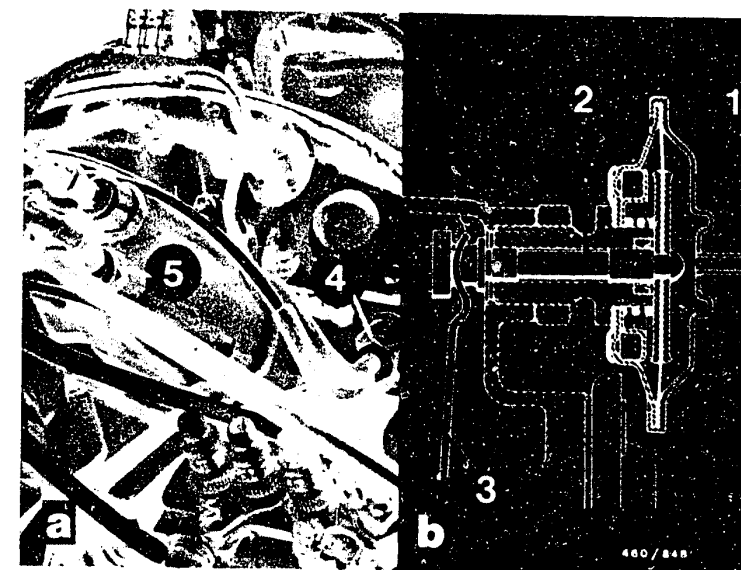
Engine idling.
Connect vacuum pump to straight connection of
thermo-valve (5) and apply 500 mbar.
Engine speed must increase by approx. 100
 min^{-1} .
Does engine speed increase by approx. 100
 min^{-1} ?

no

Test thermo-valves (4 and 5).
Thermo-valve (4) must open at coolant
temperatures below approx. $+17^{\circ}\text{C}$;
thermo-valve (5) must be closed.
If necessary, renew thermo-valve.

yes

Continued on C18/C19



- 1 = Vacuum unit
- 2 = Push rod
- 3 = Idle spring
- 4 = Thermo-valve
- 5 = Thermo-valve

C16

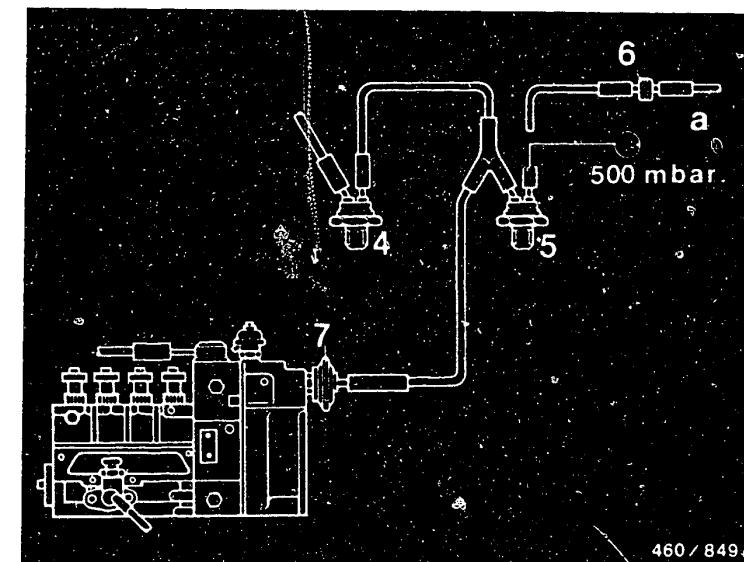
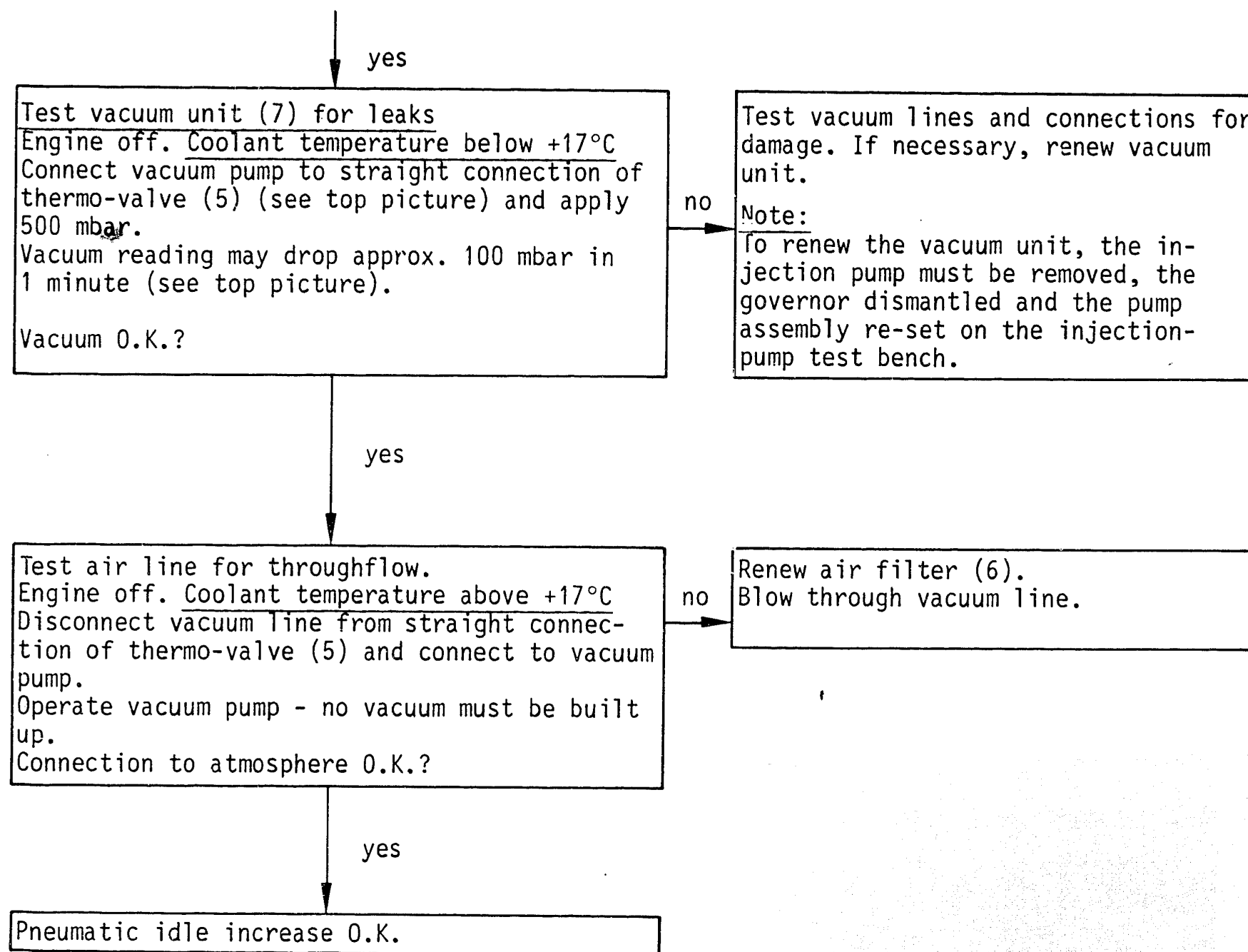
Test pneumatic idle increase
Mercedes Benz 190 D



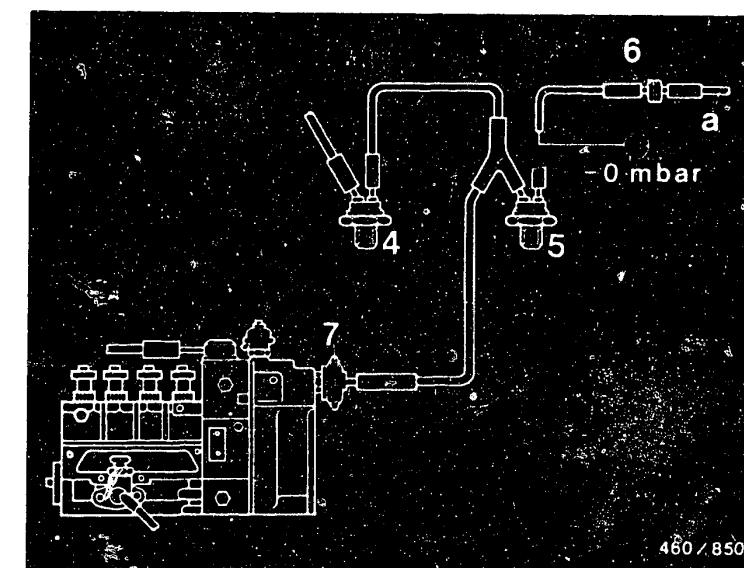
C17

Test pneumatic idle increase
Mercedes Benz 190 D





a = Air line
 4 = Thermo-valve
 5 = Thermo-valve
 6 = Air filter
 7 = Vacuum unit



C18

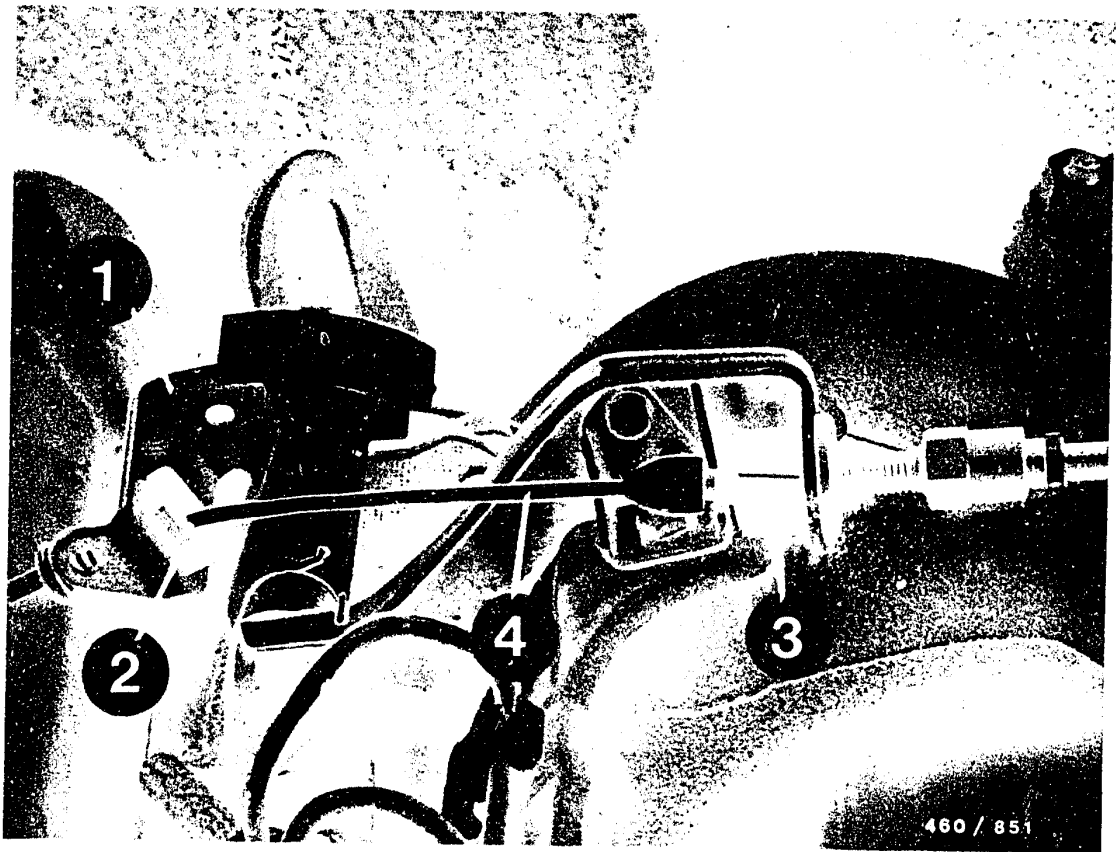
Test pneumatic idle increase
 Mercedes Benz 190 D



C19

Test pneumatic idle increase
 Mercedes Benz 190 D





- 1 = Bell crank
- 2 = Guide piece
- 3 = Expansion clamp
- 4 = Cable

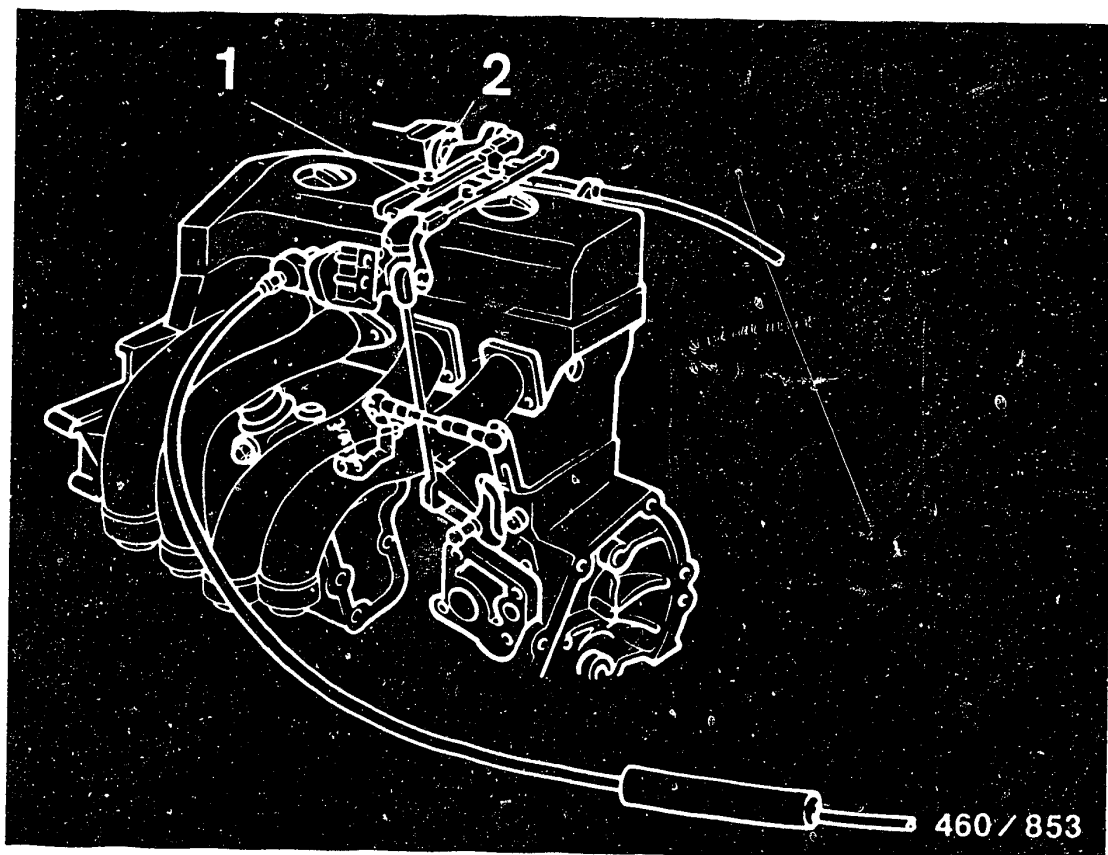
17. Adjust engine-speed regulation mechanism

Check regulating linkage for damage (deformation) and wear; check cable for freedom of movement. Renew defective parts.

Note:

Press out slotted guide piece on bell crank. Press together expansion clamp, as a result of which cable can be unhooked and removed.

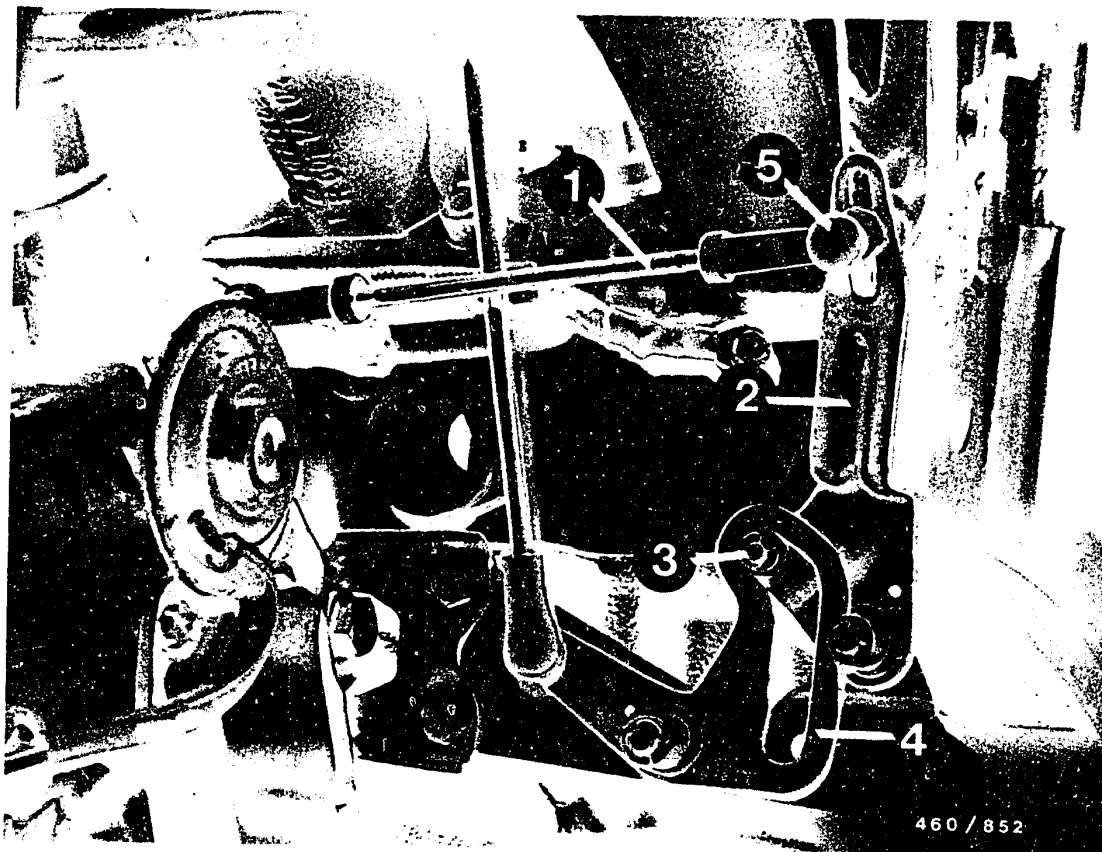




- 1 = Connecting rod
2 = Cruise control

17.1 Test and adjust idle stop on vehicles with manual transmission

Check whether control lever of injection pump is up against idle stop. To do this, unhook connecting rod on cruise control.



1 = Connecting rod
2 = Deflection lever
3 = Roller

4 = Variable-fulcrum lever
5 = Ball head (adjustable)

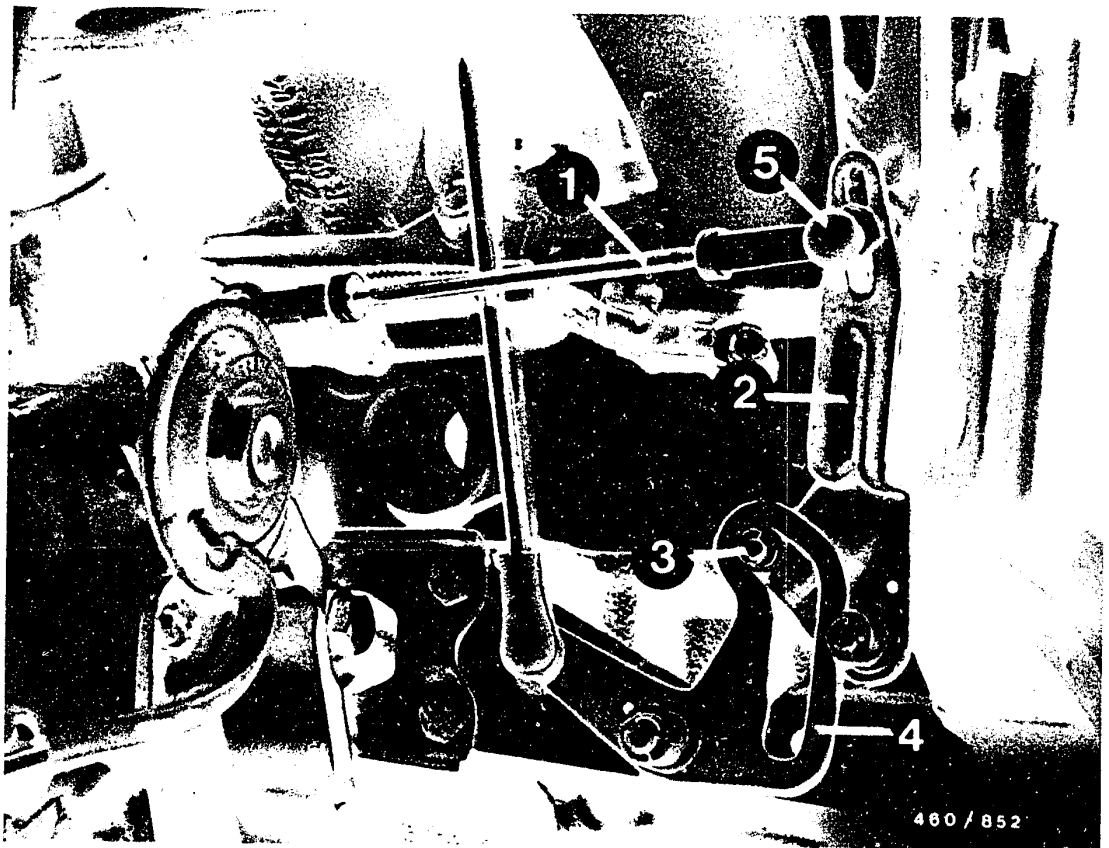
17.2 Test and adjust idle stop on vehicles with auto- matic transmission

Unhook adjustable connecting rod on deflection lever. Check whether control lever of injection pump is up against idle stop.

Hook in connecting rod free of tension. Make sure that roller in variable-fulcrum lever is up against end stop free of tension (see picture). If necessary, adjust connecting rod.

Setting dimension of connecting rod from centre of ball head to centre of ball head = 146 ± 8 mm.





1 = Connecting rod
2 = Deflection lever
3 = Roller

4 = Variable fulcrum lever
5 = Ball head (adjustable)

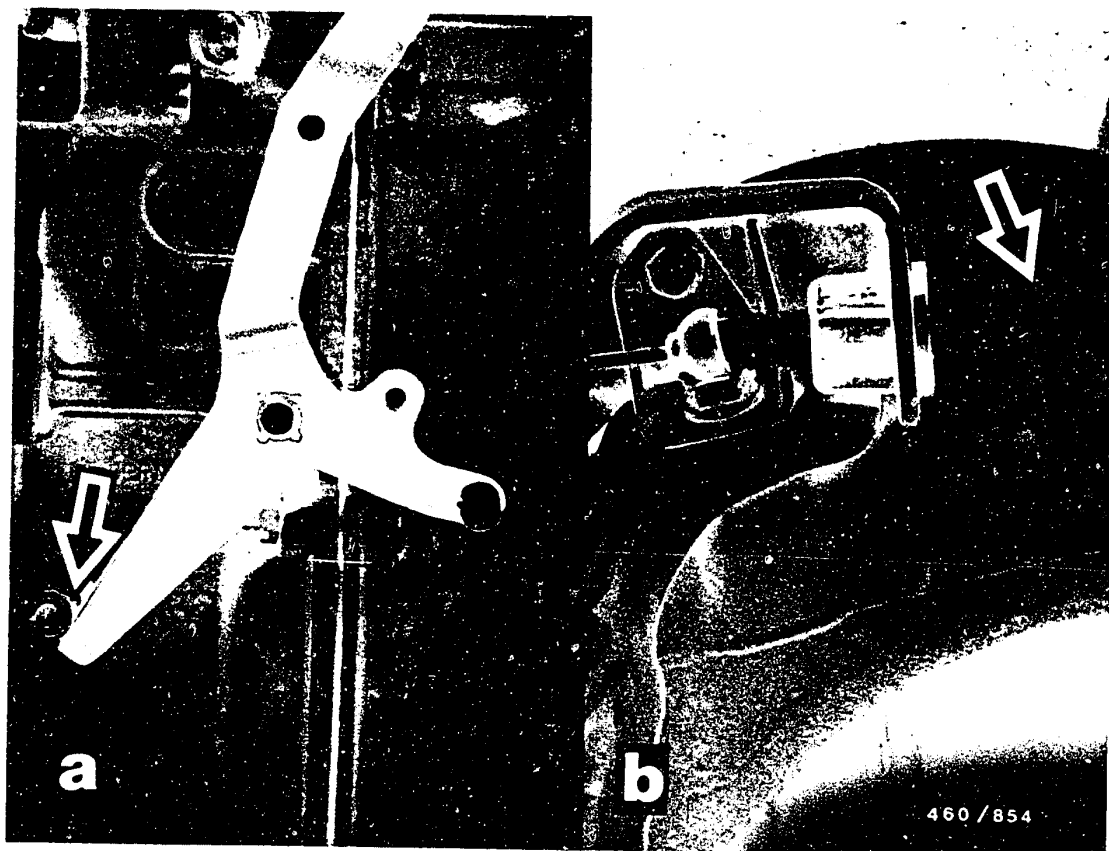
Pull variable-fulcrum lever to full load. Injection-pump control lever must be up against full-load stop. If control lever is not up against full-load stop, loosen adjustable ball head, slide in deflection lever slot and lock again.

C23

Adjust eng.-speed reg. mechanism

Mercedes Benz 190 D





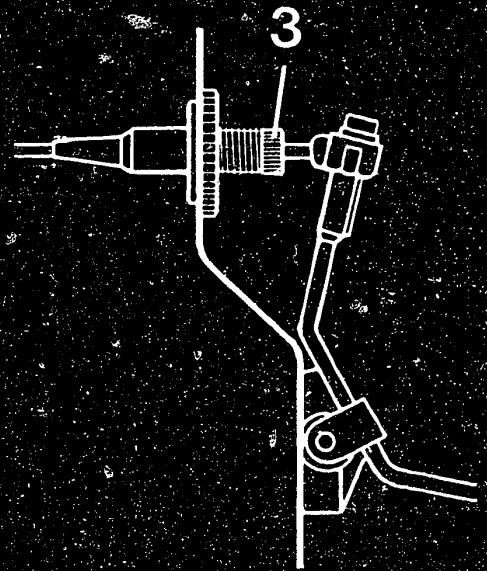
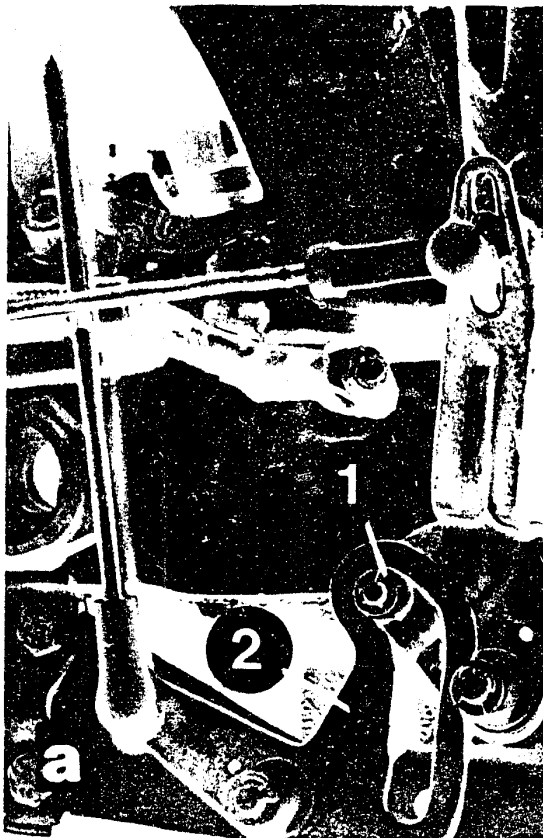
17.3 Test and adjust full-load stop on vehicles with manual and automatic transmission

With engine stopped, press accelerator in passenger compartment as far as full-load stop or, in case of automatic transmission, as far as stop on kickdown switch.

Injection-pump control lever must be up against full-load stop (arrow, picture a).

Check by pressing the connecting rod. If necessary, adjust by means of adjusting screw (arrow, picture b) on cable.





460 / 8560

- 1 = Roller
- 2 = Variable-fulcrum lever
- 3 = Adjusting nut

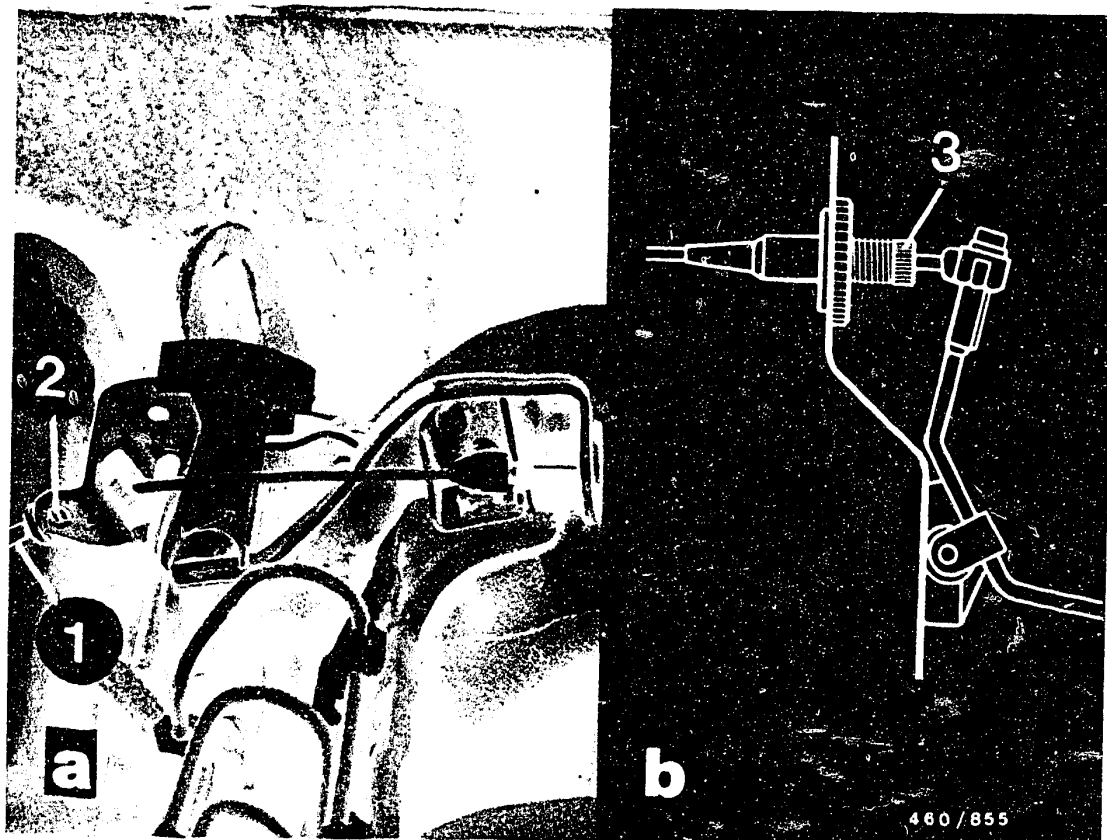
Slowly ease off accelerator from full-load position into idle position. In this position, the roller in the variable-fulcrum lever must be up against end stop free of tension (see picture a). If necessary, correct adjustment in passenger compartment by means of adjusting nut (picture b).

D1

Adjust eng.-speed reg. mechanism

Mercedes Benz 190 D



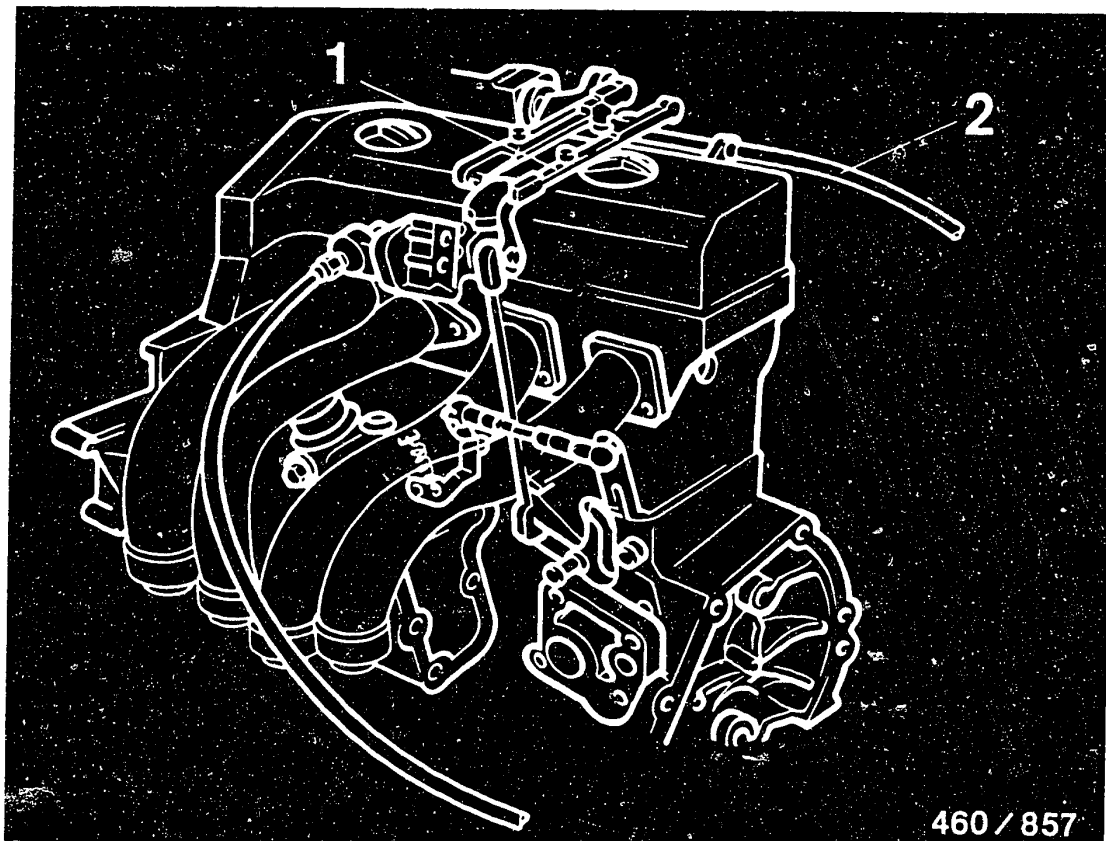


- 1 = Cable nipple
- 2 = Compression spring
- 3 = Adjusting nut

In the idle position, the nipple of the cable must be up against the compression spring free of tension (picture a).

If necessary, appropriately adjust cable from passenger compartment by means of adjusting nuts.





460 / 857

- 1 = Idle travel rod
- 2 = Control pressure cable

17.4 Adjust control pressure cable

Unhook control pressure cable ball socket. Extend idle travel rod as far as it will go. Pull control pressure cable forward until slight resistance can be felt.

In this position, hold ball socket over ball head and hook in free of tension.

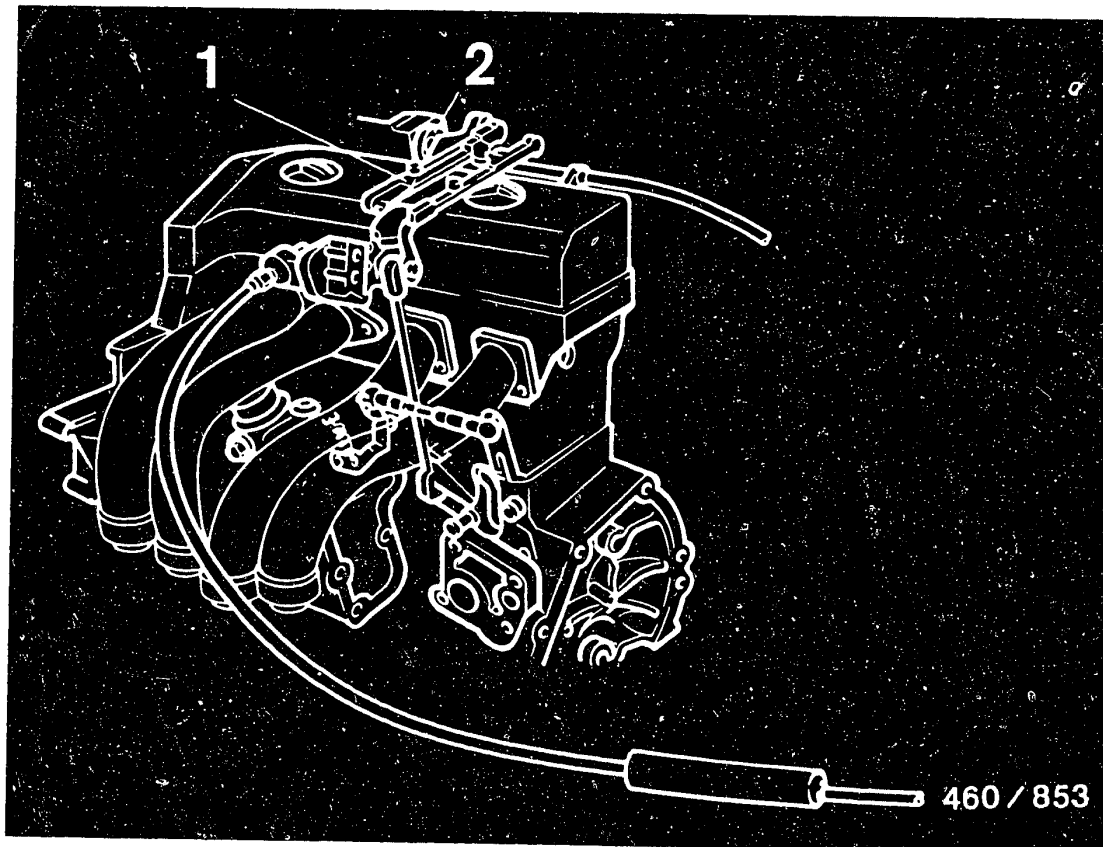
If necessary, move idle travel rod to do this.

D3

Adjust eng.-speed reg. mechanism

Mercedes Benz 190 D





- 1 = Connecting rod
- 2 = Cruise control
- 3 = Deflection lever

17.5 Adjust cruise control

Unhook connecting rod on actuator and press deflection lever into idle position.

Adjust length of connecting rod so that it is 1 mm shorter than the actual maximum gap. Hook in connecting rod and lock.



18. Test vacuum control valve

Test conditions

Engine at normal operating temperature. Regulating linkage adjusted. Disconnect black/white vacuum line (see picture, arrow) and connect vacuum tester. Test vacuum at idle speed. Set value: 390 - 440 mbar.

With engine stopped and regulating linkage at full-load stop set value: 0 mbar

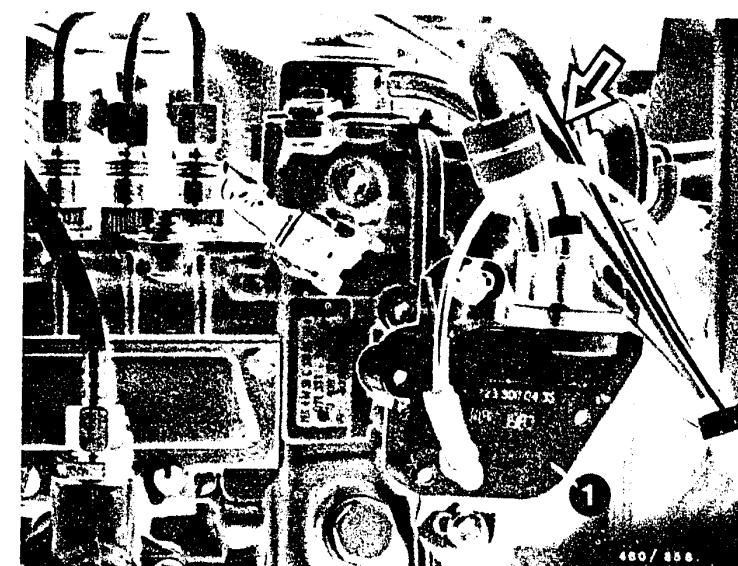
Test specifications O.K.?

yes

Vacuum control valve O.K.

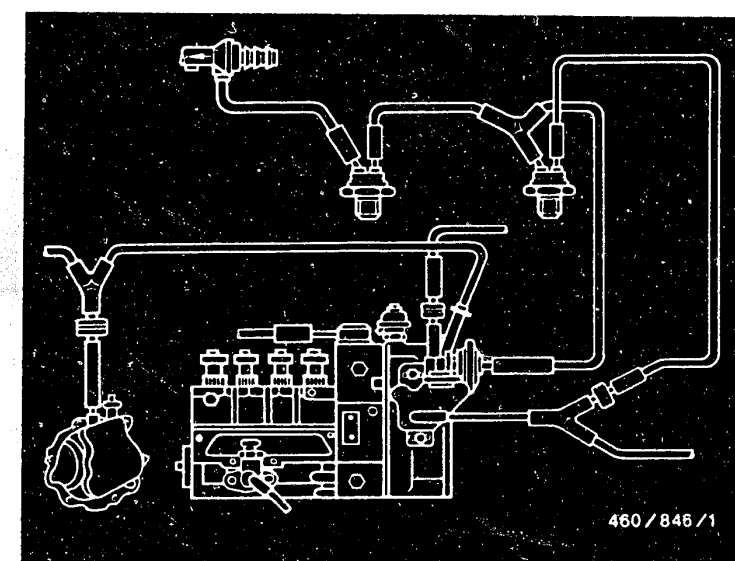
Test vacuum lines for leaks in accordance with functional diagram.

no
Adjust vacuum control valve. To do this, press injection pump regulating lever to full load. Turn vacuum control valve all the way to the right as far as it will go (slot). In this position, tighten fastening screws.



1 = Vacuum control valve

Functional diagram of vacuum



D5

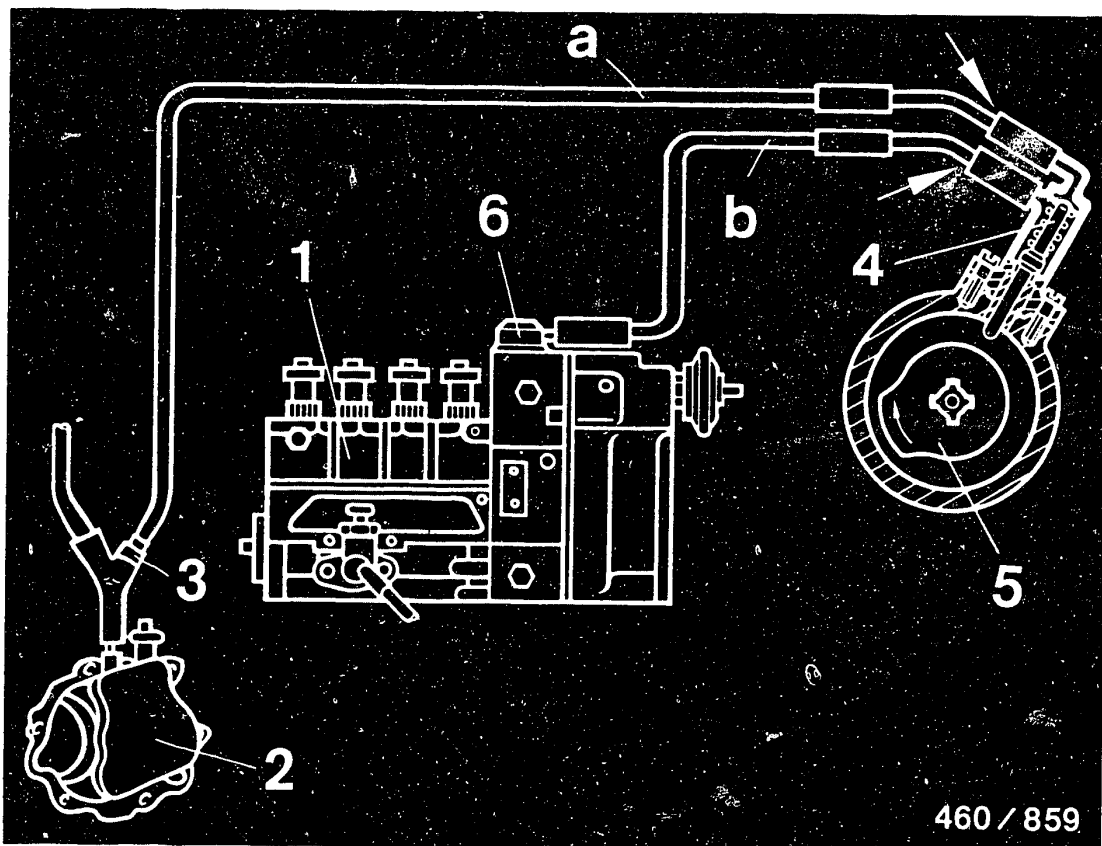
Test vacuum control valve
Mercedes Benz 190 D



D6

Test vacuum control valve
Mercedes Benz 190 D





460 / 859

- a = Suction line (brown)
- b = Control line (brown/blue)
- 1 = Injection pump
- 2 = Vacuum pump
- 3 = Restriction
- 4 = Valve for key-operated starting system
- 5 = Glow-plug and starter switch disc cam
- 6 = Vacuum unit (shutoff box)

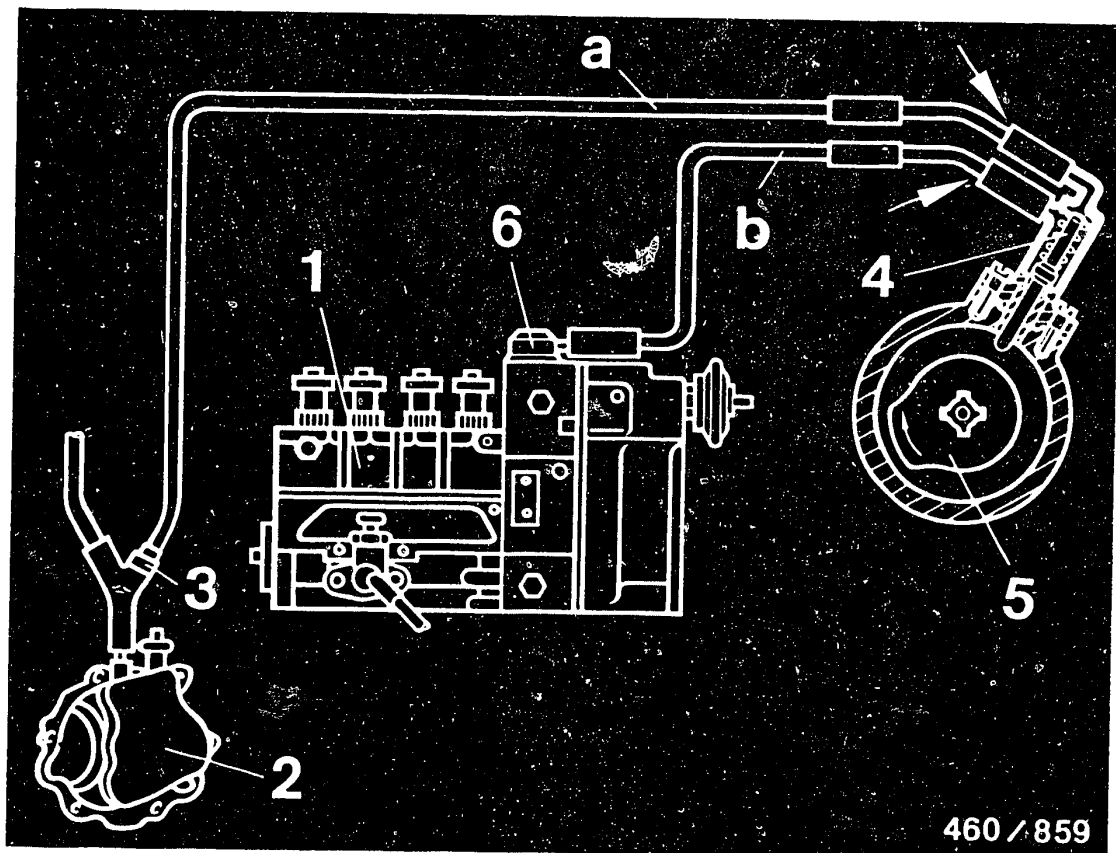
19. Test vacuum shutoff for leaks

D7

Test vacuum shutoff for leaks

Mercedes Benz 190 D





460 / 859

Set glow-plug and starter switch to position "2". Pull suction line (a, brown) out of connecting piece (arrow). Connect vacuum pump to connecting piece and apply 500 mbar vacuum. There must be no loss of vacuum, otherwise valve for key-operated starting system (4) leaking.

Return glow-plug and starter switch to position "0". There must be no loss of vacuum; otherwise valve for key-operated starting system (4) or vacuum unit (shutoff box) (6) leaking. Renew valve and/or vacuum unit. Remove vacuum pump from suction line (a); re-connect suction line (a).

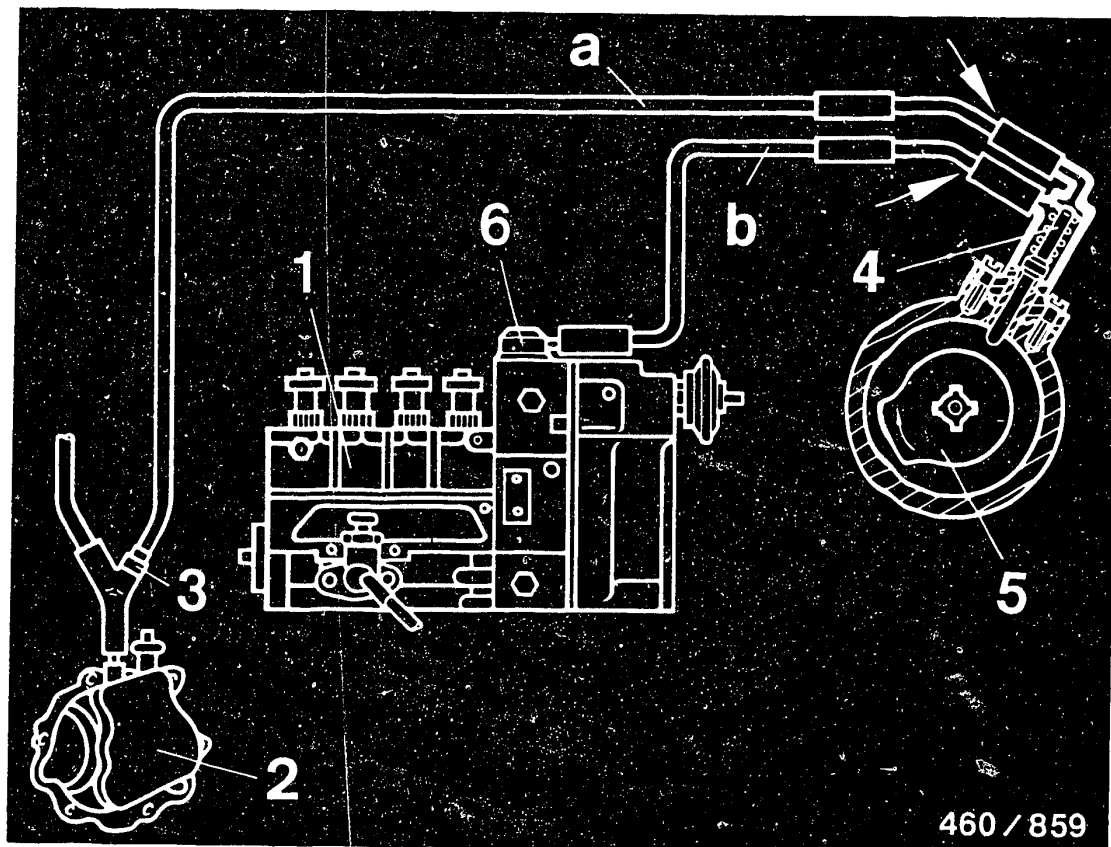
Note: Before renewing the valve and/or vacuum unit, test vacuum lines and their connecting pieces for leaks.

D8

Test vacuum shutoff for leaks

Mercedes Benz 190 D





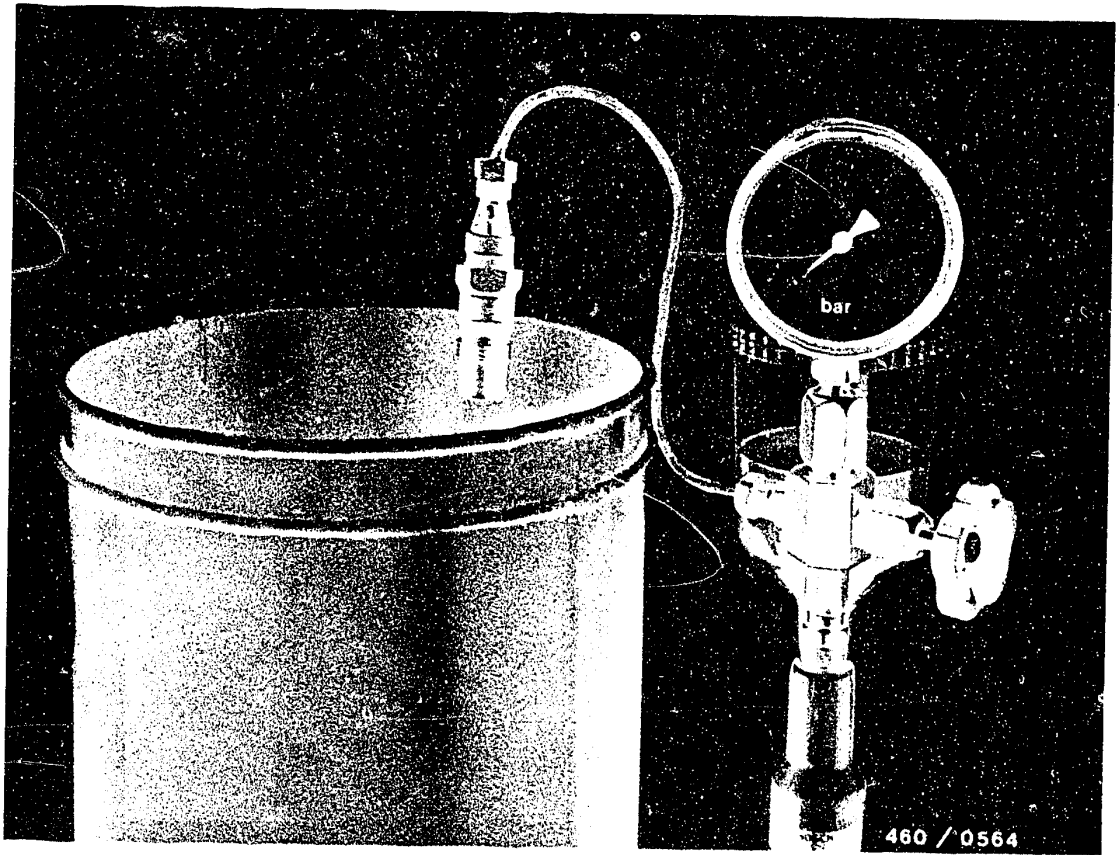
Set glow-plug and starter switch to position "0". Disconnect control line (b, brown/blue) from connecting piece (arrow). Connect vacuum pump to control line and apply 500 mbar vacuum. There must be no loss of vacuum; otherwise vacuum unit (6) or control line leaking.

D9

Test vacuum shutoff for leaks

Mercedes Benz 190 D





20. Test injection nozzles

Remove injection nozzles.

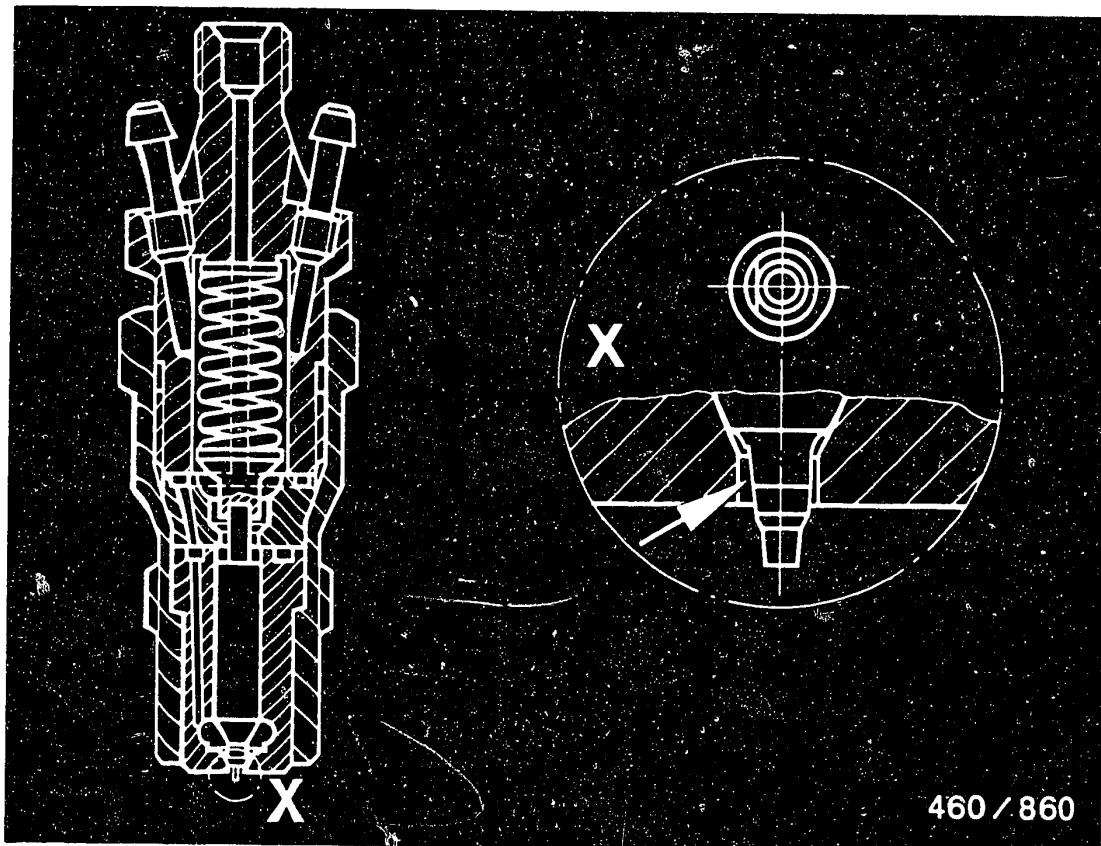
The test is performed using the nozzle tester EFEP 60 H, 0 681 200 502.

Mount injection nozzle with nozzle-holder assembly on nozzle tester.

Caution:

When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into the skin and may cause blood poisoning.





460 / 860

Vehicles of the Europe version are equipped with flat pintle nozzles.

They differ from hole-type pintle nozzles due to a flat on the throttling pintle (see picture, arrow).

D 11

Test injection nozzles

Mercedes Benz 190 D



20.1 Chatter test (flat pintle nozzle)

The pressure gauge is switched off.

First of all, slowly move hand lever; the nozzle must chatter; likewise, when the lever is moved quickly and jerkily (4...6 downward movements/sec).

As the lever speed is raised there is a range in which the nozzle does not chatter.

In this chatterless range the calibrating oil may escape in the form of a cord.

Note:

The chattering indicates that the nozzle needle is not restricted in its movement and that the nozzle seat as well as its guide are mechanically correct.

The shape of the spray is not important for the chatter test.

20.2 Check injection pressure

Switch on pressure gauge.

Slowly force lever downward. When nozzle begins to squirt, read off injection pressure.

In the case of deviations from the nominal value, the nozzle-opening pressure must be adjusted by shims behind the pressure spring in the nozzle-holder assembly.

Nominal value: new nozzles 115-125 bar

Nominal value for used nozzles: min. 100 bar

Thicker shims = higher nozzle-opening pressure

Thinner shims = lower nozzle-opening pressure

+/- 0.05 mm of shim causes approx. 5.0 bar pressure difference.



Note:

When assembling the injection nozzle, pay attention to the tightening torque of 70 to 90 Nm.

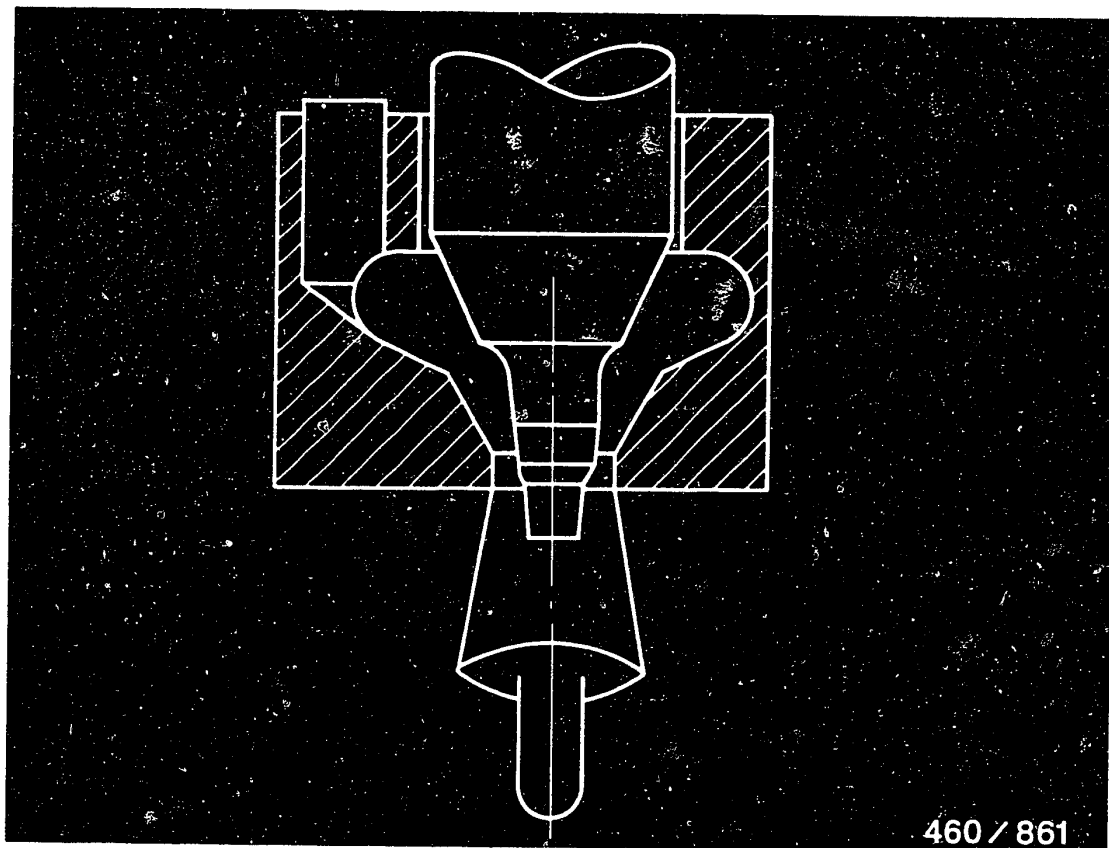
If the tightening torque is exceeded, the nozzle needle may stick.

20.3 Leak test

Switch on pressure gauge.

Slowly force lever downward and maintain pressure approx. 20 bar below opening pressure for 10 seconds. The nozzle must not drip during this period.





460 / 861

20.4 Spray test

Switch off pressure gauge.

Until the high whistling tone is reached, the spray may be in strands and may be unatomized. A split, discontinuous spray is not important in this range. The spray pattern cannot be assessed until when the lever is being operated quickly (4...6 downward movements per second).

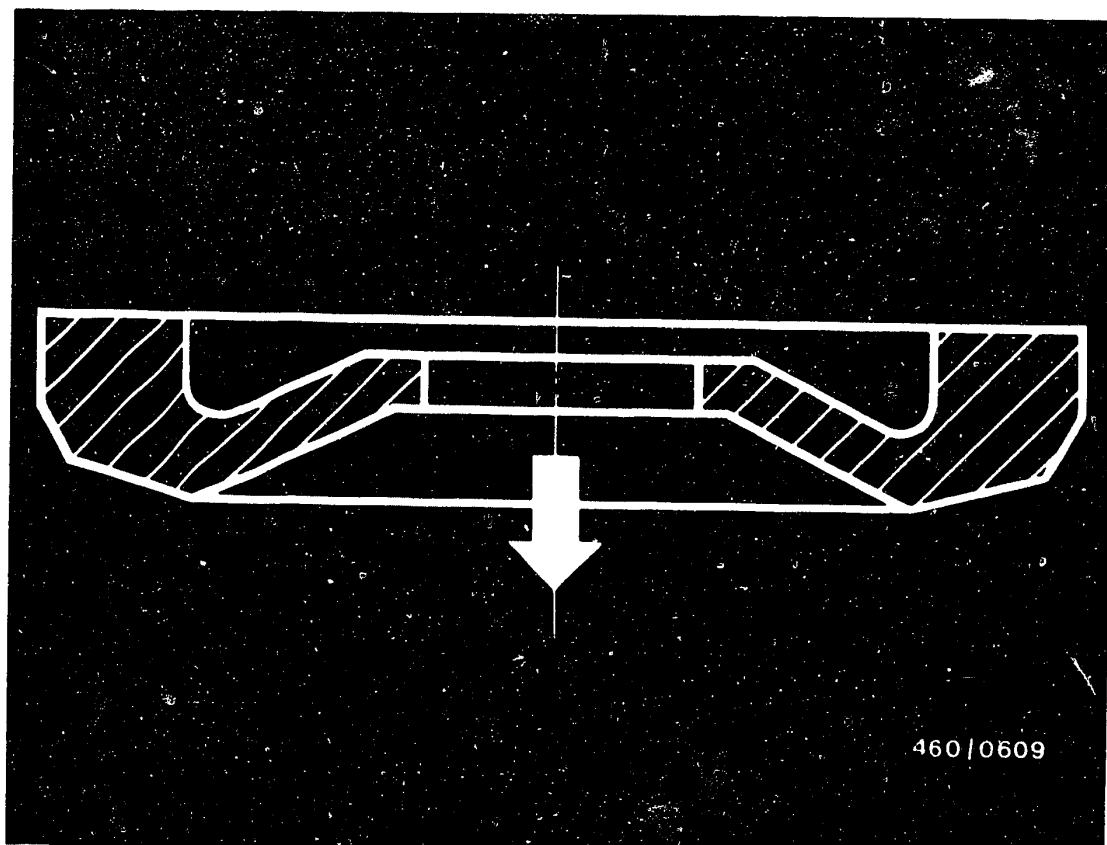
The spray must then be well atomized. The cross section of the spray has an oval shape and is larger than the spray of a throttling pintle nozzle without a flat on the pintle.

D14

Test injection nozzles

Mercedes Benz 190 D





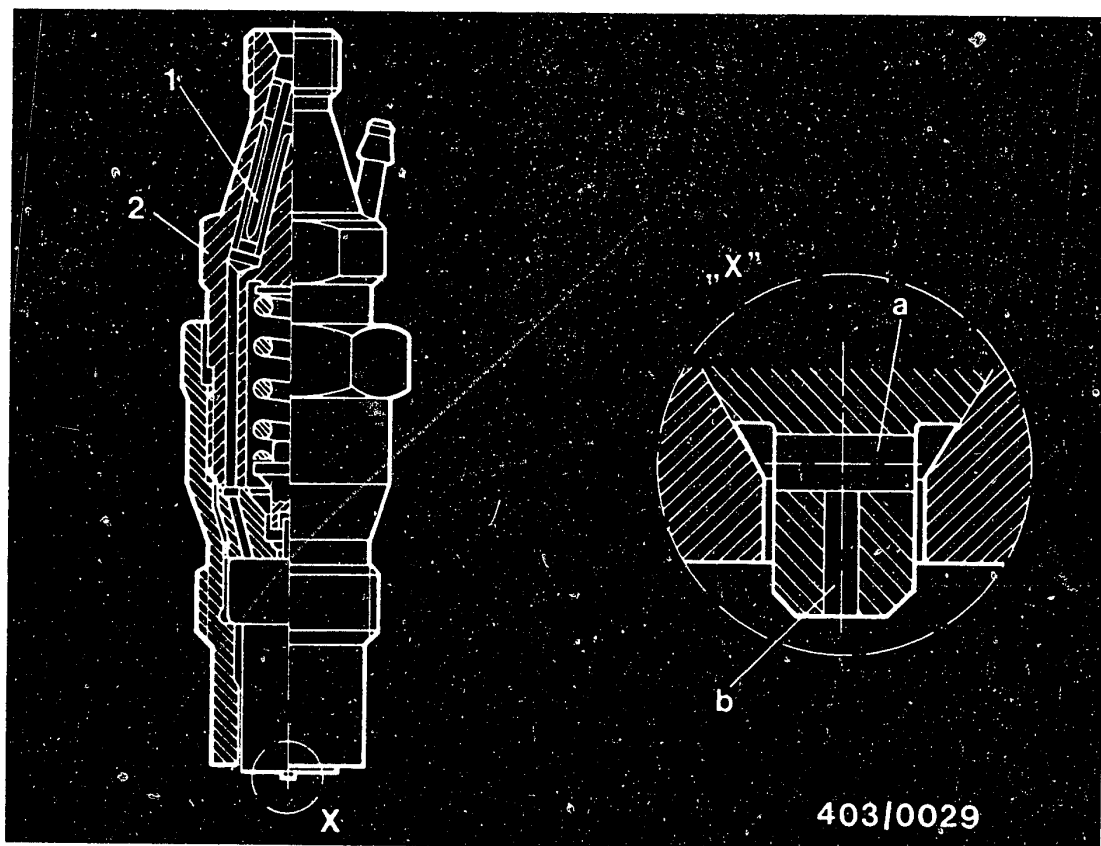
20.5 Install injection nozzles

Before installing the injection nozzles, insert new heat-protection washers the right way round (see picture, arrow) in cylinder head (sealing cone 150° direction of combustion chamber).

Screw in nozzle-holder assembly and tighten to 70 - 80 Nm.

Secure union nuts of fuel-injection tubing to 10 - 20 Nm.





20.5 Vehicles of the USA version are equipped with hole-type pintle nozzles

These differ from DN 0 SD 220 due to a transverse bore (a) and a longitudinal bore (b) in the pintle and due to a narrower throttling gap. Furthermore, the top part (2) of the injection nozzle is equipped with a maintenance-free edge-type filter (1).

20.6 Chatter test

Due to its special structural features the so-called throttling nozzle chatters very softly. A chatter test is only possible at between 1...2 downward movements per second. As the speed is raised the chattering stops. The calibrating oil then escapes from the nozzle with a hissing noise. The nozzle does not chatter with a high-pitched tone until the lever is moved quickly (approx. 4...6 downward movements per second).

20.7 Check injection pressure

Switch on pressure gauge.

Slowly force lever downward. When nozzle begins to squirt, read off injection pressure.

In the case of deviations from the nominal value, the nozzle-opening pressure must be adjusted by shims behind the pressure spring in the nozzle-holder assembly.

Nominal value - new nozzles: 115 - 125 bar.

Nominal value - used nozzles: min. 100 bar.

Note: When assembling the injection nozzle, pay attention to the tightening torque of 70 ... 90 Nm. If the tightening torque is exceeded, the nozzle needle may stick.



20.8 Leak test

Switch on pressure gauge.

Slowly force lever downward and maintain pressure approx. 20 bar below opening pressure for 10 seconds. The nozzle must not drip during this period.

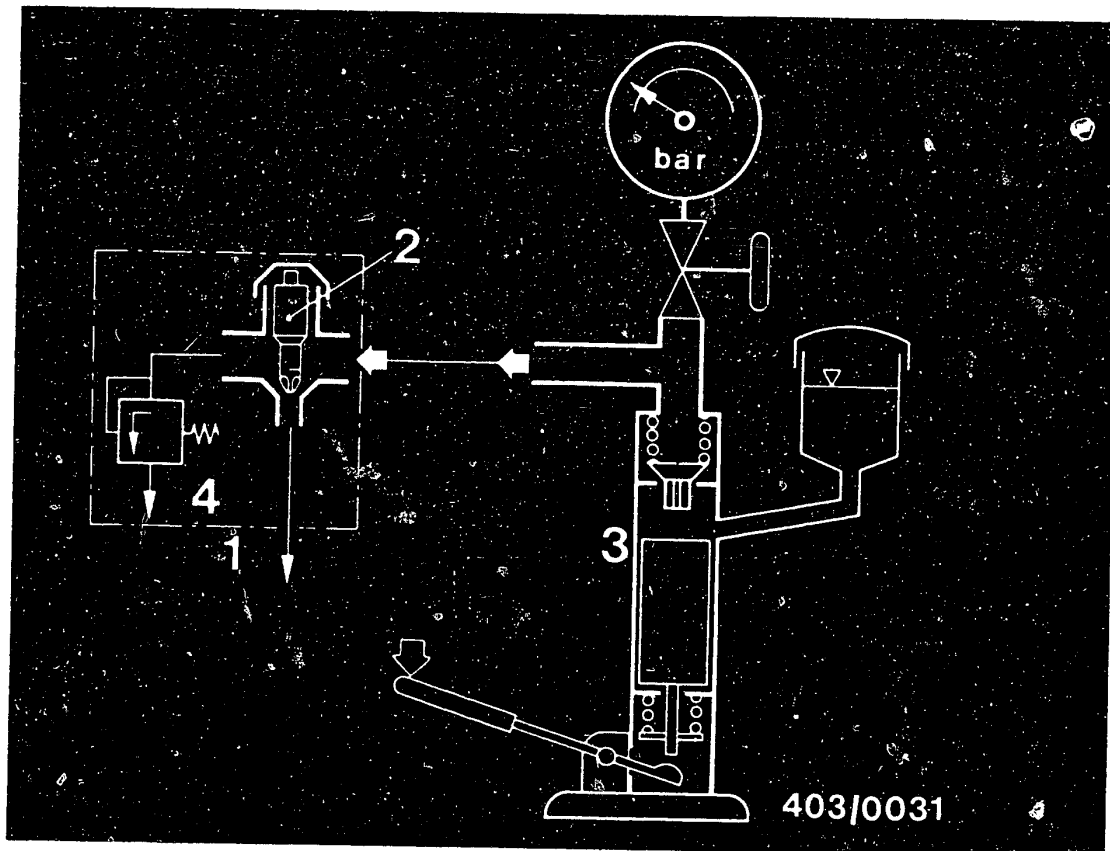
20.9 Chatter test

Spray pattern

Until a high whistling tone is reached, the spray is in strands and is unatomized. A split, discontinuous spray is not important in this range (chattering on throttling stroke).

The spray pattern cannot be assessed until the lever is moved quickly (4...6 downward movements/second). The spray must then be concentrated and well atomized (chattering on full stroke of nozzle needle).



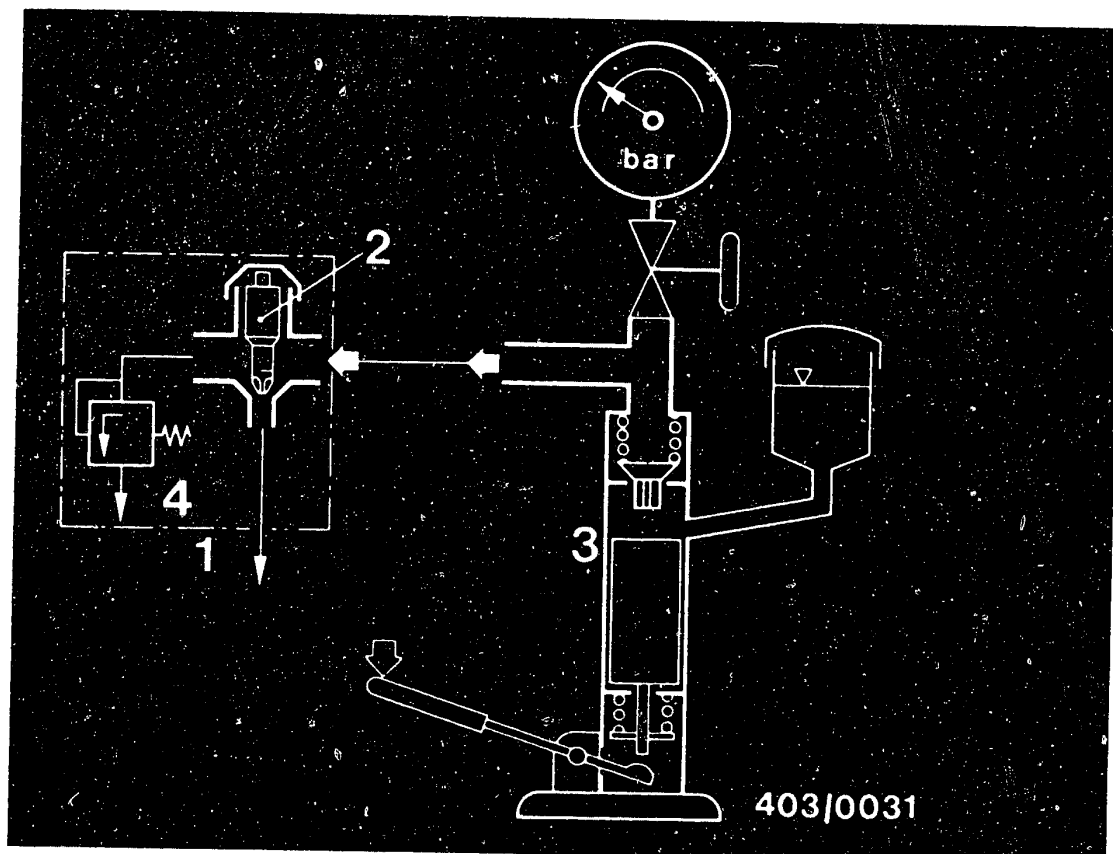


- 1 = DN test accessories 1 688 130 153 (overflow valve)
 2 = Hole-type pintle nozzle (object under test)
 3 = Nozzle tester 0 681 200 502 (EFEP 60 H)

20.10 Testing the longitudinal bore in the nozzle needle

The needle tester 1 688 130 153 is required for this additional test.





Test sequence

Remove the nozzle-and-holder assembly.

Introduce nozzle needle into needle tester 1 688 130 153 (1) and tighten clamping nut by hand.

Connect needle tester to nozzle tester and increase pressure until oil escapes from overflow valve.

When the lever continues to be moved uniformly and slowly (4...6 seconds for one downward movement of lever) a fine, clear axial spray must escape from the centre bore of the nozzle needle (arrow).



20.11 Cleaning the nozzle needle

If a cord spray is not visible, the longitudinal bore must be cleaned with nozzle cleaner KDEP 2900 or the nozzle must be renewed.

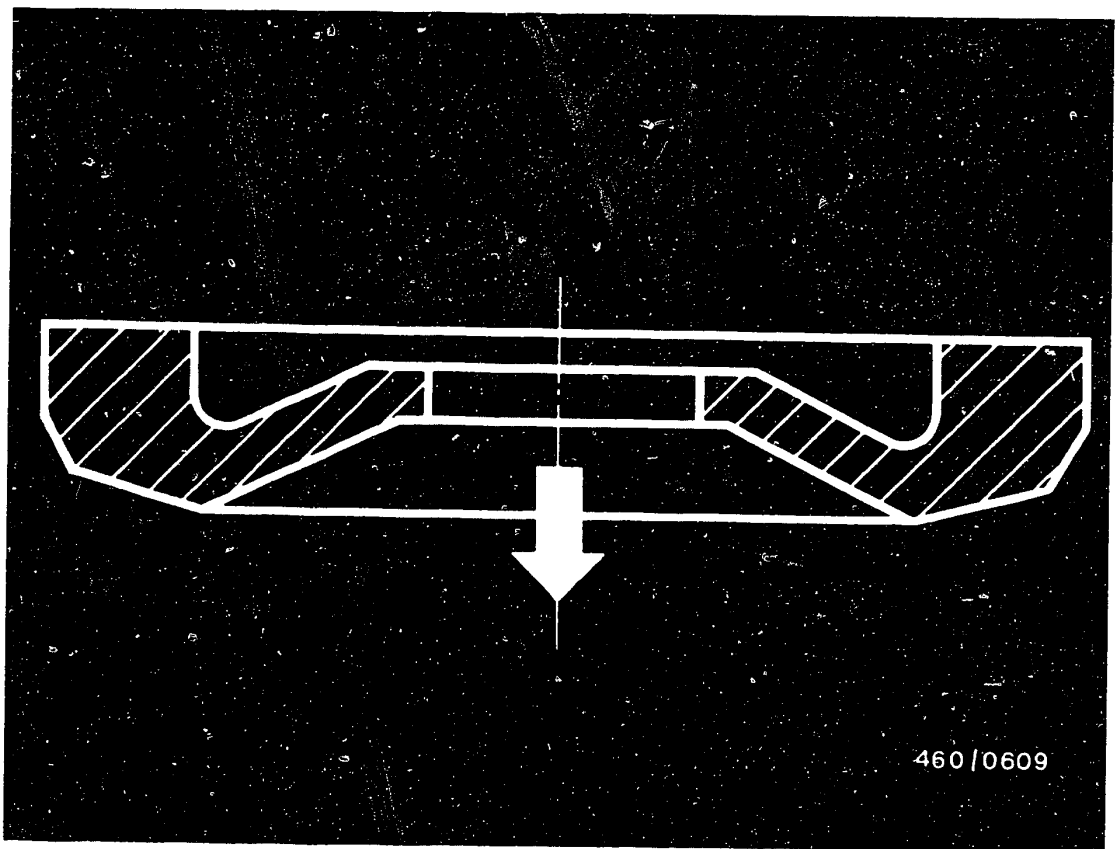
Use cleaning needle KDEP 2900/3 (\varnothing 0.13 mm) for the version of nozzle with a short pintle (bore \varnothing 0.15 mm). For nozzles as of FD 345 (bore \varnothing 0.20 mm) use cleaning needle KDEP 2900/5 (bore \varnothing 0.18 mm). Likewise for nozzles with long pintle (bore \varnothing 0.20 mm).

The needle with 0.13 mm diameter, as a special accessory, is not contained with the nozzle cleaner. It must be ordered separately. The needle with 0.18 mm diameter is contained in KDEP 2900.

Note:

Nozzle needle and nozzle body are mated and must not be mixed up.





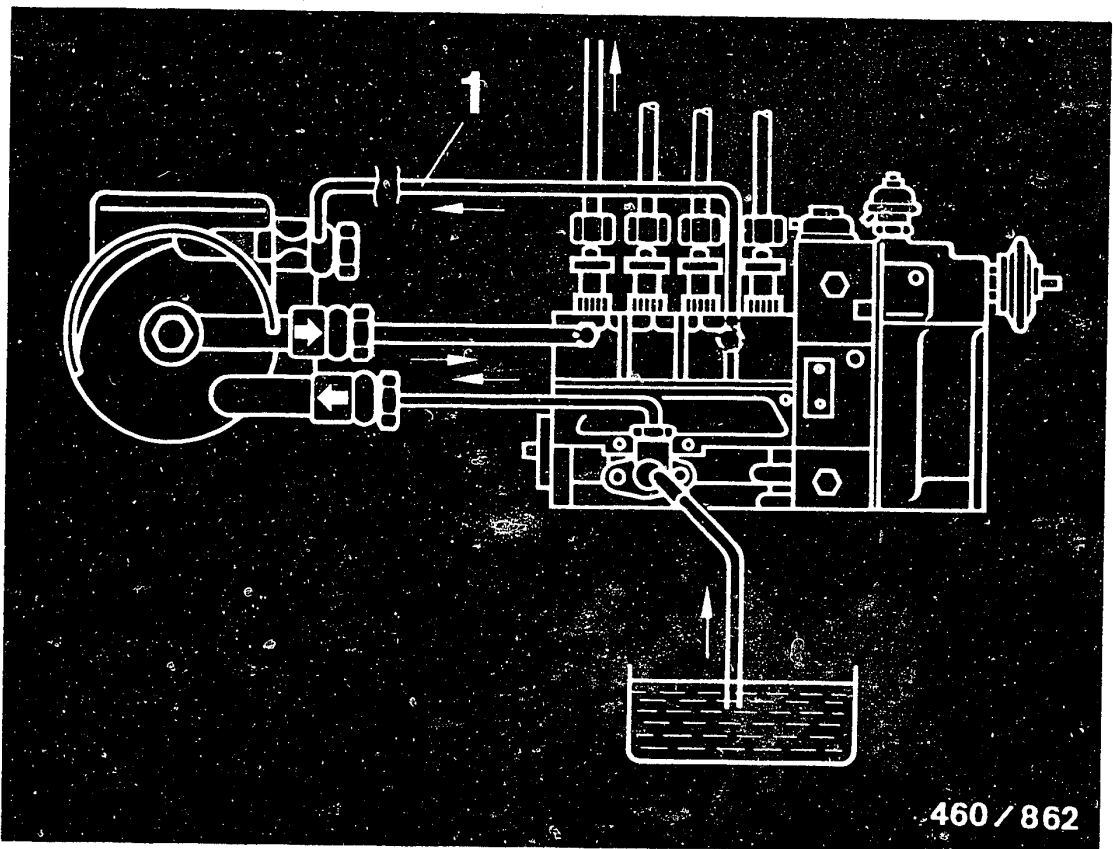
20.12 Install injection nozzles

Before installing the injection nozzles, insert new heat-protection washers the right way round (see picture, arrow) in cylinder head (sealing cone 150° direction of combustion chamber).

Screw in nozzle-holder assembly and tighten to 70 - 80 Nm.

Secure union nuts of fuel-injection tubing to 10 - 20 Nm.





21. Test fuel filter

Remove return line (1) from fuel filter and hold in measuring beaker.

Lock emergency stop lever in stop position.

Bring glow-plug and starter switch to position "0".

Using jumper cable (one connection to starting motor terminal 50, terminal 30 to battery positive) crank engine for 30 seconds.

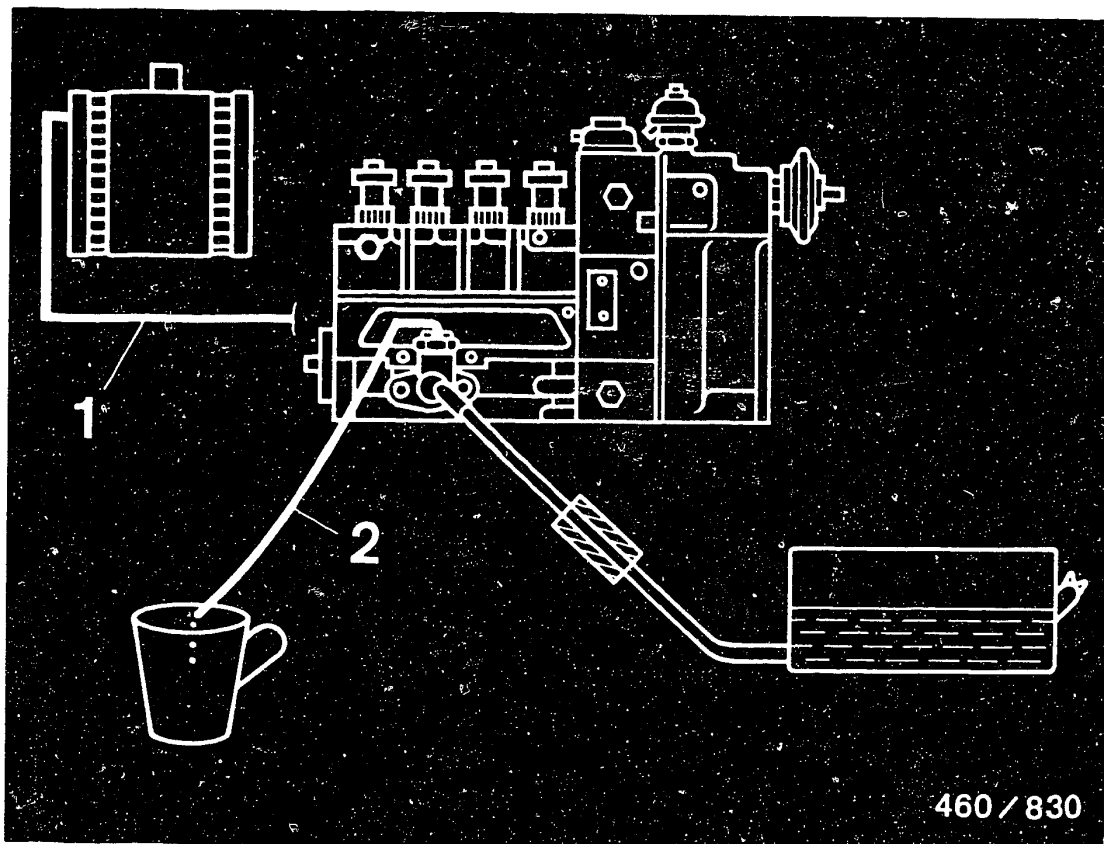
If battery intact (10 V during cranking) a fuel delivery of approx. 200 ml/30 s must be reached.



If the value is not reached, check the following points.

- Overflow valve on injection pump.
- Check fuel filter for fouling. If necessary, mount a new filter element with housing and seal ring.





460 / 830

22. Test fuel supply pump

22.1 Testing the fuel delivery

Loosen pressure line (1) on supply pump.

Connect test line (2) to supply pump and hold test line in measuring beaker.

Lock emergency stop lever in stop position.

Bring glow-plug and starter switch to position "0".

Using jumper cable (one connection to starting motor terminal 50, terminal 30 to battery positive) crank engine for 30 seconds.

If battery intact (10 V during cranking) a fuel delivery of approx. 200 ml/30 s must be reached.

E1

Test fuel pump

Mercedes Benz 190 D



23. Test preheating system

23.1 Necessary test equipment

Voltmeter/ammeter e.g. ETT 011.00

0 684 101 100

Multimeter with digital display commercially available

23.2 Workshop information

We recommend that the R-type sheathed-element glow plugs be replaced every 45 000 km.

Note:

Incorrect setting of the start of delivery may considerably shorten the life of the sheathed-element glow plugs.

For each repeat start the glow-plug and starter switch must, in order to obtain renewed preheating, first of all be set to position 1, then to position 2. This makes it possible for the safety circuit installed in the glow-duration unit to be re-activated.

23.1 Preheating time

The on-time of the preheating system is dependent on the ambient temperature.

23.4 Test conditions

Battery fully charged.

Compression O.K., if necessary test compression loss.

Fuel supply/injection system O.K.

23.5 Fault indication

A fault in the preheating system is indicated by the failure of the glow-plug indicator lamp to light up when the glow-plug and starter switch is in position 2.

The following faults are covered:

- Open circuit in lead term. 30 to glow-duration unit
- Fuse 80 A defective
- Power relay in glow-duration unit defective
- Open circuit in one or more leads to sheathed-element glow plugs
- One or more sheathed-element glow plugs defective



Starting motor operates, engine fails to start or starts only with great difficulty

yes

Test power supply to R-type sheathed-element glow plugs

Connect voltmeter to R-type sheathed-element glow plug and to ground.
Set glow-plug and starter switch to position 1 and then to position 2.
For at least 7 seconds (temperature-dependent) a minimum voltage of 10 V must be indicated.
After this time the system switches off automatically.

Caution:

If the measurement has to be repeated, first of all set glow-plug and starter switch to position 1 and then to position 2.

Minimum voltage present?

yes

Test current consumption of R-type sheathed-element glow plugs.

Place current pickup over the individual leads to glow-duration unit one after the other.
Set glow-plug and starter switch to position 1 and then to position 2. After 10...20 seconds the current consumption of each sheathed-element glow-plug must be 8...15 A.

Current consumption reached?

yes

Continued on E5/E6

no

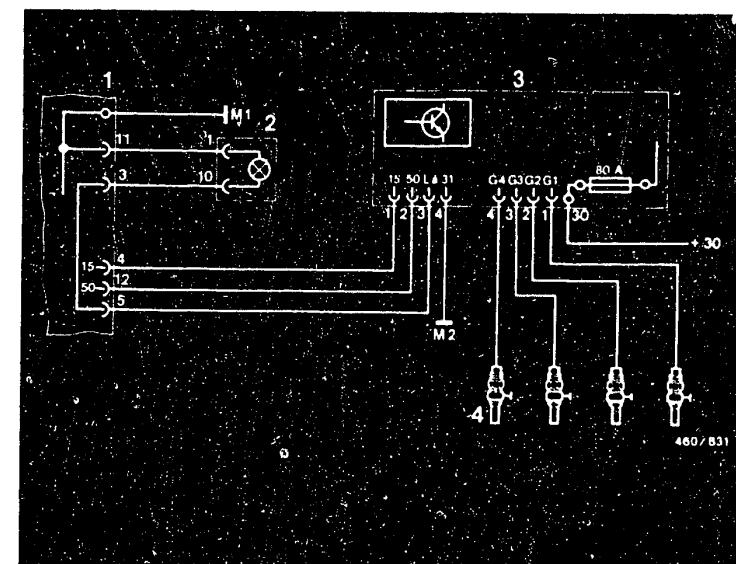
1. Voltage below 10 V, then test for voltage drop in power circuit (battery +) as well as term. 30 on glow-duration unit including 80 A fuse.

Eliminate voltage drop.

2. If no voltage, test for open circuit in leads between R-type sheathed-element glow plugs and glow-duration unit term. G1 - G4. Eliminate open circuit.
If no open circuit, continue on Coordinate E11/E12.
Not necessary to continue here.

If current consumption above 15 A, renew R-type sheathed-element glow plug. Below 8A, test for open circuit in electric lead or R-type sheathed-element glow-plug. To do this, disconnect 6-fold connector on glow-duration unit. Using ohmmeter, measure sockets 1...4 (corresponding to R-type sheathed-element glow plugs of cyl. 1...4), to ground (engine block) (see bottom picture).

Ohmmeter must indicate 0 Ω . If reading $\infty \Omega$ open circuit in lead or R-type sheathed-element glow plug.
Eliminate open circuit or replace R-type sheathed-element glow plug.



1 = Central-electrics console

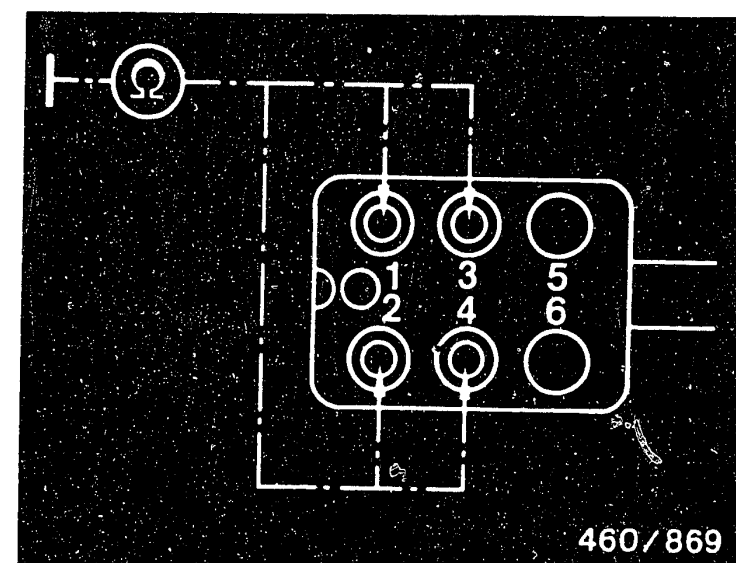
2 = Glow-plug indicator lamp (in instrument cluster)

3 = Glow-duration unit

4 = R-type sheathed-element glow plug

M 1 = Main ground (behind instrument cluster)

M 2 = Ground at front left (near lamp unit)



460/869

E3

Test preheating system

Mercedes Benz 190 D



E4

Test preheating system

Mercedes Benz 190 D



Test preheating system (continued)

Note:

It is possible that the glow-plug indicator lamp (as a result of unfavourable tolerances) will indicate a fault only when 2 R-type sheathed-element glow plugs in cyl. 2...4 have failed.

To ensure that the fault indication in the glow-duration unit is not defective, disconnect 2 sheathed-element glow plugs of cyl. 2...4 and repeat preheating process. If indicator lamp now indicates a fault (not lit) glow duration unit is O.K.

Test glow-plug indicator lamp
Set glow-plug and starter switch to position 1 and then to position 2. Glow-plug indicator lamp must light up.
Glow-plug indicator lamp lit?

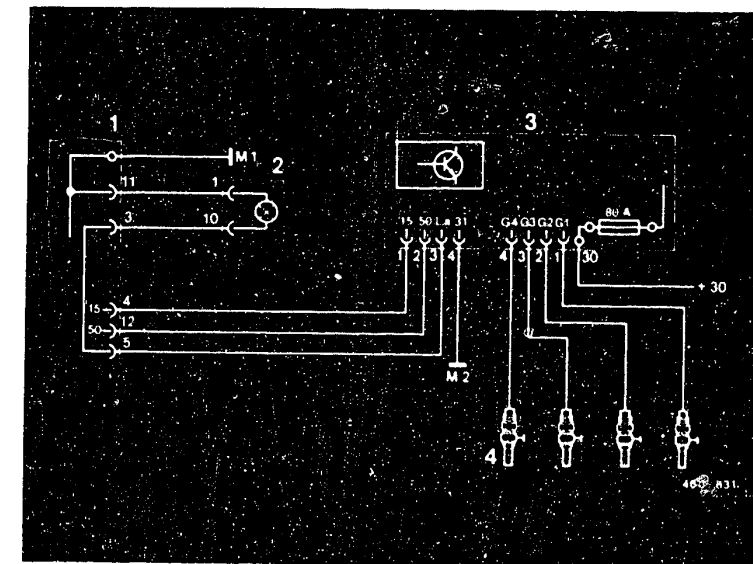
Set glow-plug and starter switch to position 1 and then to position 2. Glow-plug indicator lamp must light up.

Glow-plug indicator lamp lit?

no	term. 4 and glow-duration unit
----	--------------------------------

1. Test for open circuit in lead between central-electrics console term. 4 and glow-duration unit term. 15. Eliminate open circuit.
2. Test for open circuit in lead between glow-duration unit term. 1a and glow-plug indicator term. 10 including ground lead term. 1 to main ground (behind instrument cluster). Eliminate open circuit.

Continued on E7/E8



- 1 = Central-electrics console
- 2 = Glow-plug indicator lamp
(in instrument cluster)
- 3 = Glow-duration unit
- 4 = R-type sheathed-element glow plug
- M 1 = Main ground (behind instrument cluster)
- M 2 = Ground at front left (near lamp unit)

Test preheating system (continued)

yes

Test preheating time

Set glow-plug and starter switch to position 1 and then to position 2. The preheating time (glow-plug indicator lamp lit) depends on the engine compartment temperature. See graph.

Preheating time (seconds) O.K.?

no

Renew glow-duration unit.

yes

Test safety switch-off circuit

Connect voltmeter to R-type sheathed-element glow plug and to ground. Set glow-plug and starter switch to position 1 and then to position 2.

The time for the safety switch-off is no longer rigidly specified. It results from the time up to readiness for starting (going out of glow-plug indicator lamp) plus 20 - 35 seconds. During this time the voltmeter must indicate voltage (see graph).

After this time the voltmeter must indicate 0 V.

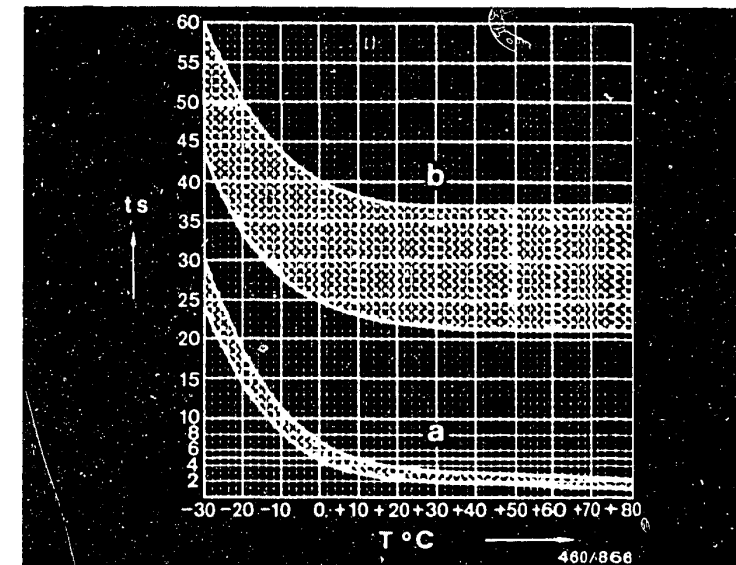
Voltmeter at 0 V after specified time?

no

Renew glow-duration unit.

yes

Continued on C23/C24



t_s = Time in seconds

T °C = Engine-comp. temp.

a = Preheating time

b = Safety switch-off

E7

Test preheating system

Mercedes Benz 190 D



E8

Test preheating system

Mercedes Benz 190 D



Test preheating system (continued)

yes

Test preheating when operating starting motor

Connect voltmeter to R-type sheathed-element glow plug and to ground.
Set glow-plug and starter switch to position 2.
Voltmeter must indicate approx. 10 V.

Voltage present?

no

1. Test for open circuit in lead between glow-plug and starter switch term. 50 and glow-duration unit term. 50.
Eliminate open circuit.
2. If point 1 O.K., renew glow-duration unit.

yes

Test R-type sheathed-element glow plugs

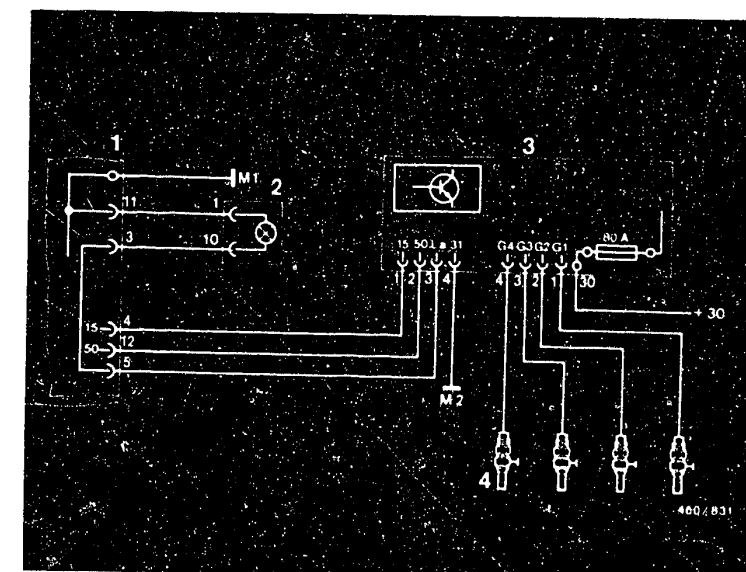
Using ohmmeter, test R-type sheathed-element glow plugs individually for continuity.
O.K.?

no

Renew R-type sheathed-element glow plugs.

yes

Preheating system O.K.
Tests as of E11 not necessary.



- 1 = Central-electrics console
- 2 = Glow-plug indicator lamp (in instrument cluster)
- 3 = Glow-duration unit
- 4 = R-type sheathed-element glow plug
- M 1 = Main ground (behind instrument cluster)
- M 2 = Ground at front left (near lamp unit)

E9

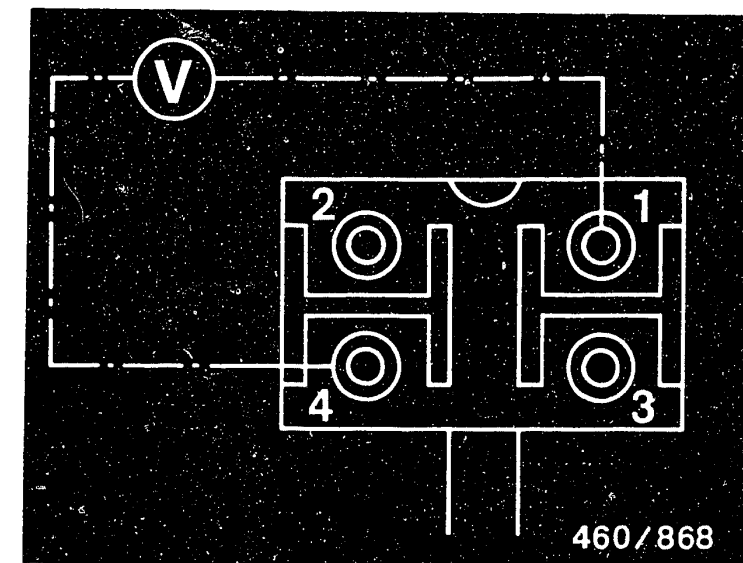
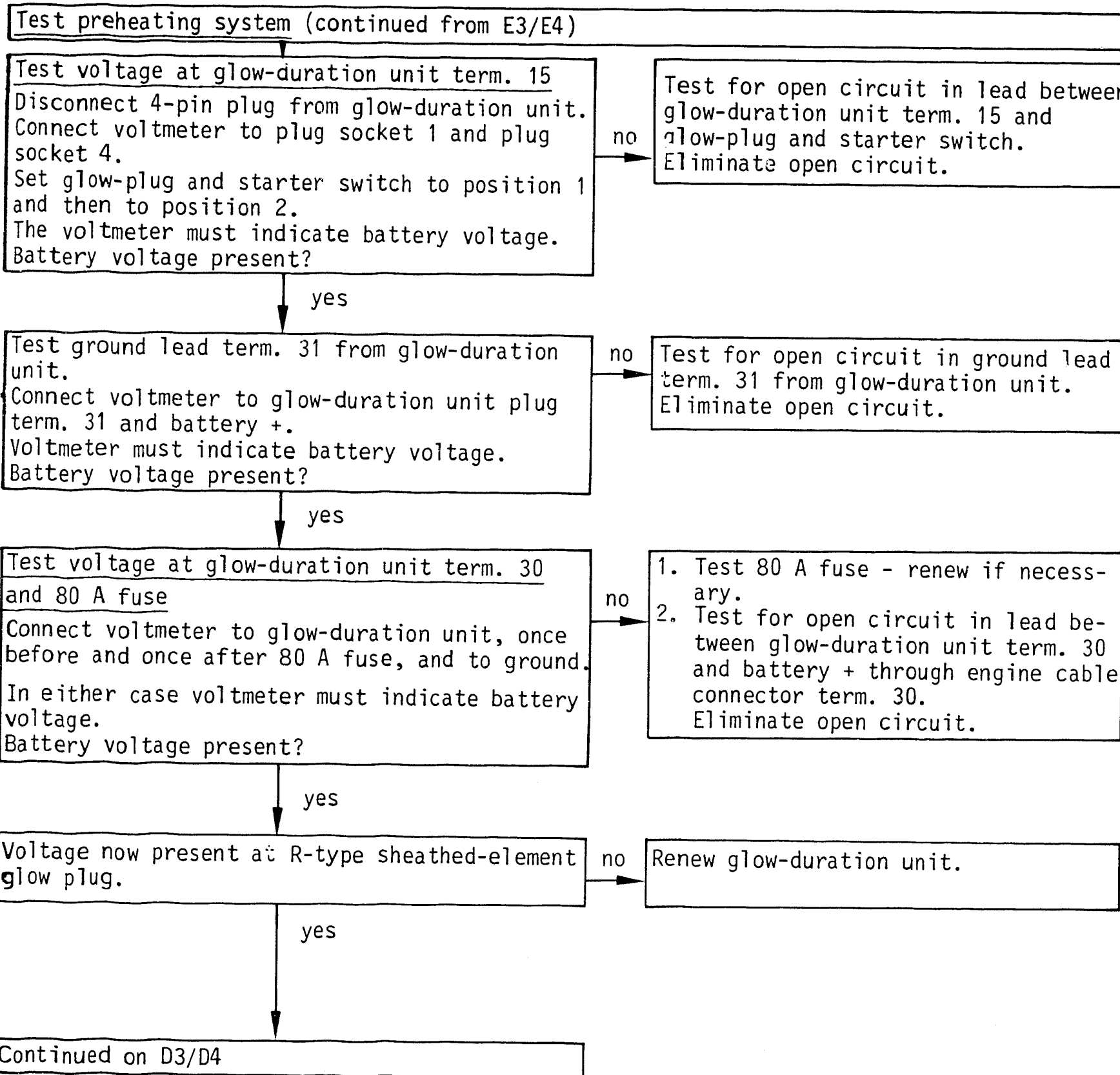
Test preheating system
Mercedes Benz 190 D



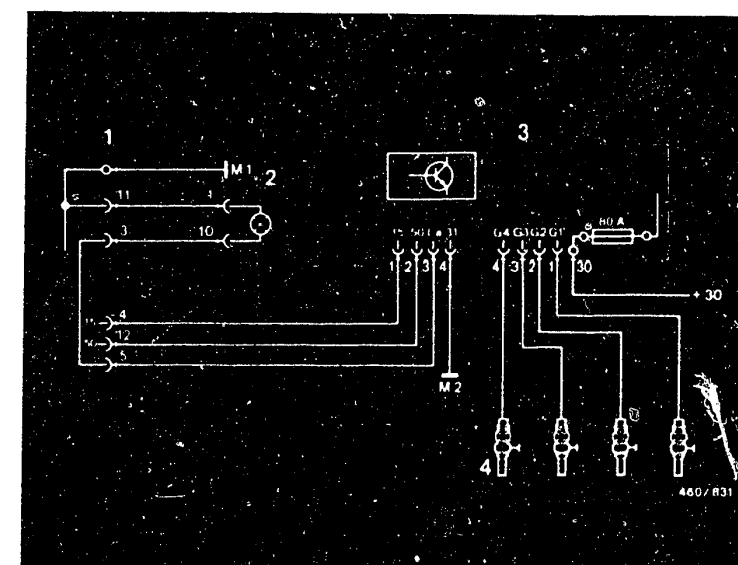
E10

Test preheating system
Mercedes Benz 190 D





- 1 = Central-electrics console
- 2 = Glow-plug indicator lamp (in instrument cluster)
- 3 = Glow-duration unit
- 4 = R-type sheathed-element glow plug
- M 1 = Main ground (behind instrument cluster)
- M 2 = Ground at front left (near lamp unig)



E11

Test preheating system
Mercedes Benz 190 D



E12

Test preheating system
Mercedes Benz 190 D



Test preheating system (continued)

yes

Test glow-plug indicator lamp

Set glow-plug and starter switch to position 1 and then to position 2. Glow-plug indicator lamp must light up.

Glow-plug indicator lamp lit?

no

1. Test bulb, renewing if necessary. If bulb O.K., test for open circuit in lead between central-electrics console term. 4 and glow-duration unit term. 15. Eliminate open circuit.
2. Test for open circuit in lead between glow-duration unit term. La (plug socket 3) and glow-plug indicator lamp term. 10 including ground lead term. 1 to main ground (behind instrument cluster). Eliminate open circuit.

yes

Test preheating time

Set glow-plug and starter switch to position 1 and then to position 2.

The preheating time (glow-plug indicator lamp lit) depends on the engine compartment temperature. See bottom graph.

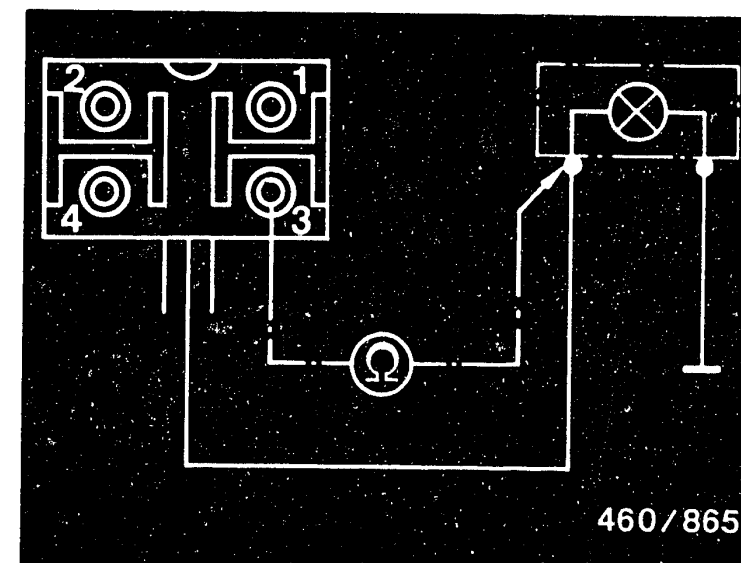
Preheating time (seconds) O.K.?

no

Renew glow-duration unit.

yes

Continued on D5/D6



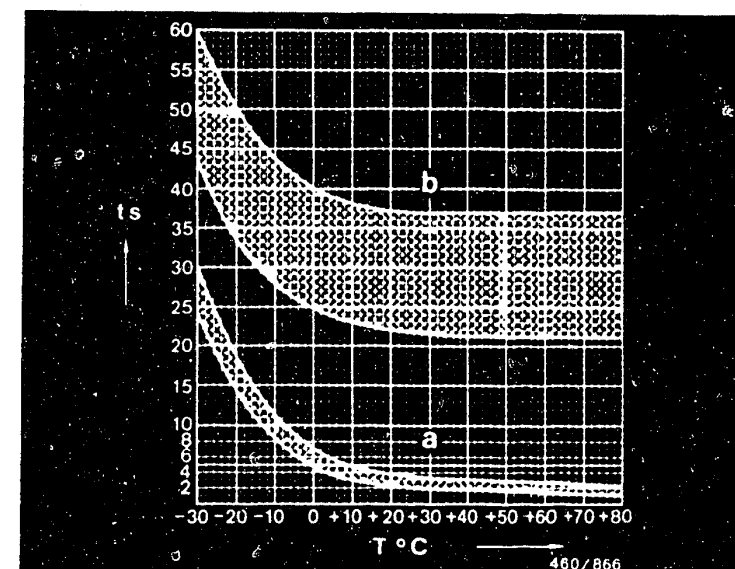
460/865

t_s = Time in seconds

T °C = Engine comp. temp.

a = Preheating time

b = Safety switch-off



460/866

E13

Test preheating system

Mercedes Benz 190 D



E14

Test preheating system

Mercedes Benz 190 D



Test preheating system (continued)

yes

Test safety switch-off circuit

Connect voltmeter to R-type sheathed-element glow plug and to ground. Set glow-plug and starter switch to position 1 and then to position 2.

The time for the safety switch-off is no longer rigidly specified. It results from the time up to readiness for starting (going out of glow-plug indicator lamp) plus 20 - 30 seconds. During this time the voltmeter must indicate voltage (see graph).

After this time the voltmeter must indicate 0 V.

Voltmeter at 0 V after specified time?

no

Renew glow-duration unit.

yes

Test preheating when operating starting motor

Connect voltmeter to R-type sheathed-element glow plug and to ground.

Set glow-plug and starter switch to position 2. Voltmeter must indicate approx. 10 V.

Voltage present?

no

1. Test for open circuit in lead between glow-plug and starter switch term. 50 and glow-duration unit term. 50. Eliminate open circuit.
2. If point 1 O.K., renew glow-duration unit.

yes

Test R-type sheathed-element glow plugs

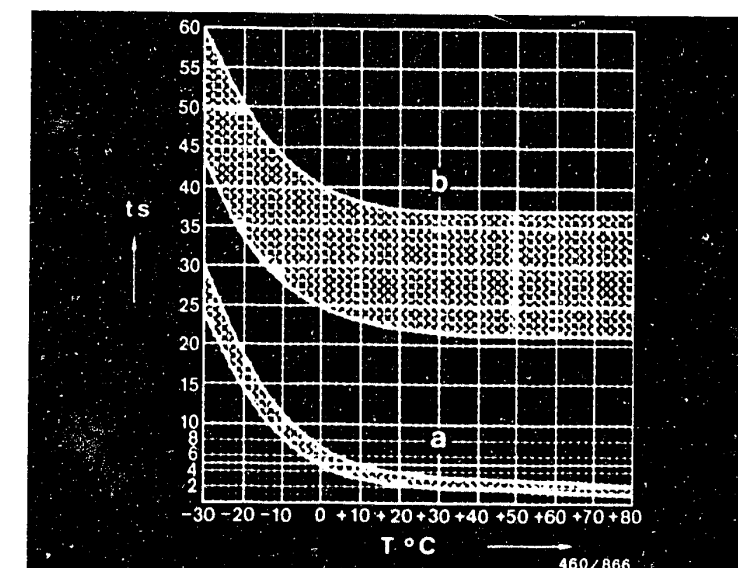
Using ohmmeter, test R-type sheathed-element glow plugs individually for continuity. O.K.?

no

Renew R-type sheathed-element glow plug.

yes

Preheating system O.K.



t_s = Time in seconds

T °C = Engine comp. temp.

a = Preheating time

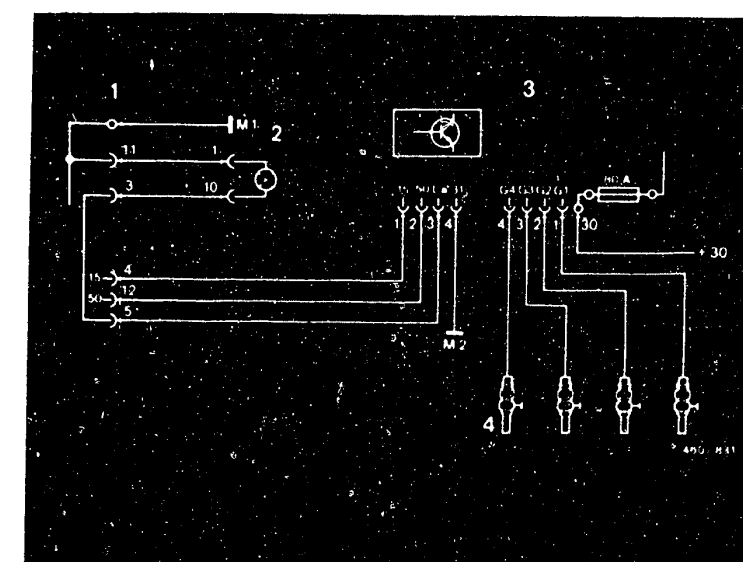
b = Safety switch-off

1 = Central-electrics console

2 = Glow-plug indicator lamp

3 = Glow-duration unit

4 = R-type sheathed-element glow plug



E15

Test preheating system

Mercedes Benz 190 D

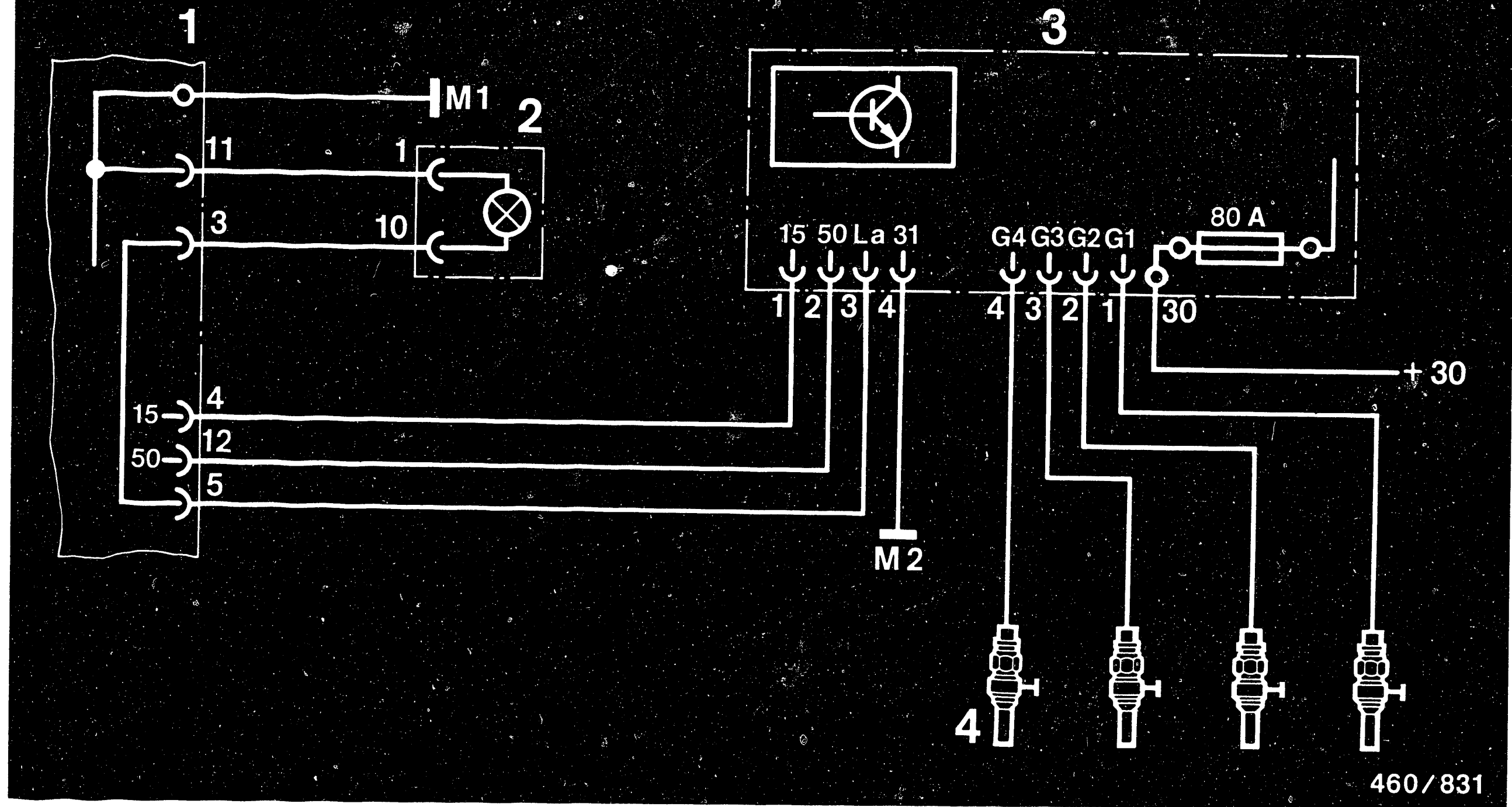


E16

Test preheating system

Mercedes Benz 190 D





1 = Central-electrics console
 2 = Glow-plug indicator lamp in instrument cluster
 3 = Glow-duration unit
 4 = Sheathed-element glow plugs

M 1 = Main ground behind instrument cluster
 M 2 = Ground at front left (near lamp unit)

23.4 Terminal diagram for preheating system

E17

Test preheating system
 Mercedes Benz 190 D



E18

Test preheating system
 Mercedes Benz 190 D



24. Check timing device

With vehicle type 201 (190 D) the operation of the timing device is tested by means of governor pulse generator and TDC pickup.

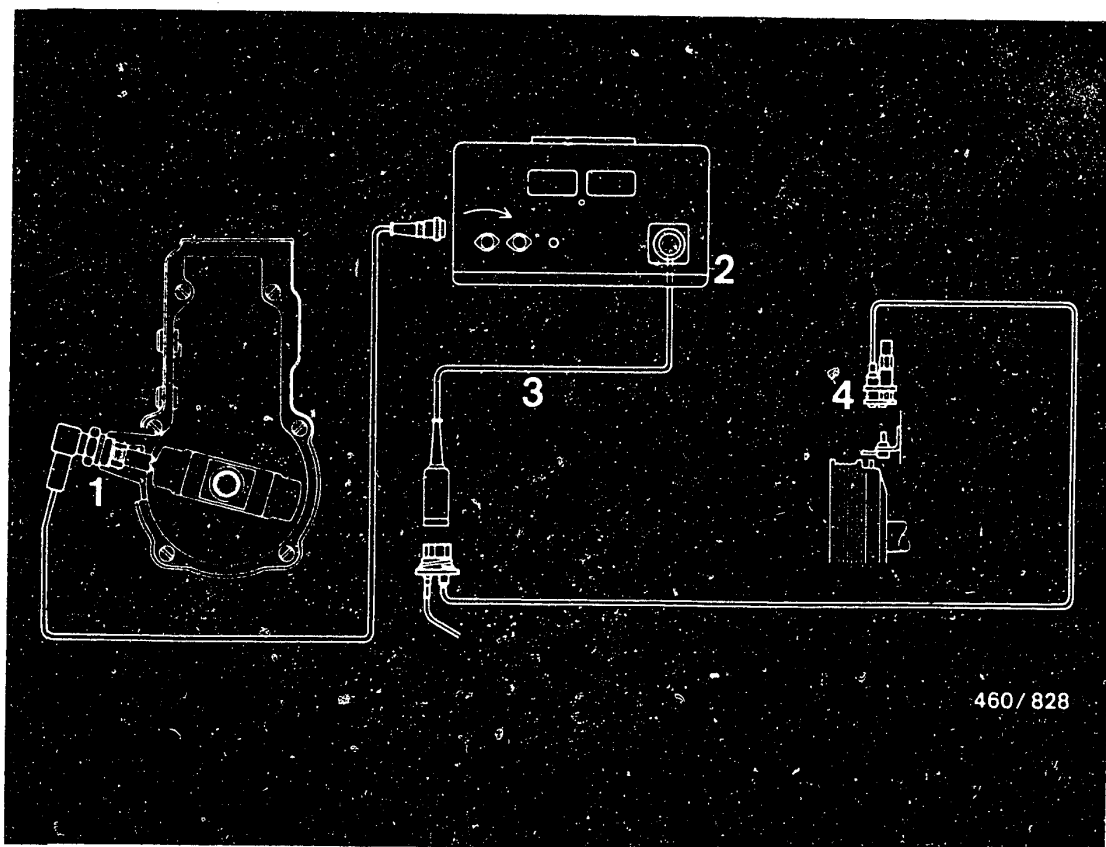
As the engine speed rises the governor pulse is advanced by the timing device.

The start of delivery reading becomes smaller and, at maximum advance, reaches approx. 1° after TDC.

Note: The advance in degrees must take place briskly and smoothly.

If no advance is detectable, the timing device is defective.





460/828

- 1 = Governor pulse generator, Daimler Benz part no. 617 589 102 100
- 2 = Diesel engine tester ETD 019.00, Bosch part no. 0 684 101 900
- 3 = Adapter lead, Bosch part no. 1 684 463 147
- 4 = TDC pickup, Daimler Benz part no. 601 589 042 100

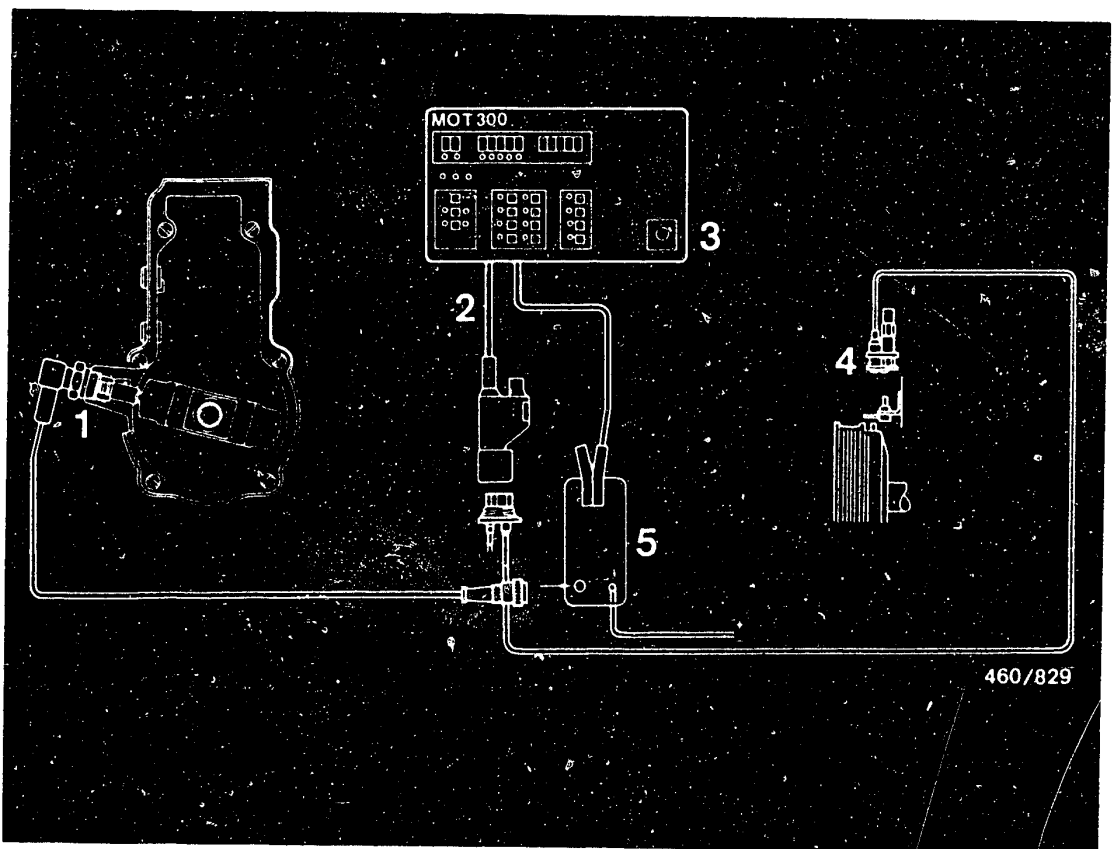
24.1 Connection diagram for testing operation of timing device with diesel engine tester ETD 019.00

E20

Check timing device

Mercedes Benz 190 D





- 1 = Governor pulse generator, Daimler Benz part no. 617 589 102 100
- 2 = Adapter lead, Bosch part no. 1 684 463 094
- 3 = Motortester MOT 300, Bosch part no. 0 684 000 300
- 4 = TDC pickup, Bosch part no. not yet specified
- 5 = Ballast unit, Bosch part no. not yet specified

24.2 Connection diagram for testing operation of timing device with ballast unit and motortester (e.g. MOT 300)



25. Measure engine compression and compression loss

25.1 Measure engine compression

Fit new chart in compression tracer. Mount high-pressure hose on tracer. Remove nozzle-holder assembly.

Turn engine over several times using starting motor so that loose carbon residues are removed from the compression space.

Screw connecting nipple of pressure tracer into opening of nozzle-holder assemblies.

Mount high-pressure hose of pressure tracer on connecting nipple.



During the following operation, note first compression stroke in particular.

Operate starting motor until there is no longer any detectable rise in pressure on the compression tracer.

Bleed compression tracer by pressing on bleeder valve.

The pointer returns to the starting position.

Move chart onto next position.

Fit connecting nipple to the other cylinders and repeat measurement.

Compression pressure	Allowable difference between cylinders
24 - 30 bar	max. 20%
Wear limit approx. 15 bar	



25.1.1 Evaluation of chart

1. Normal pressure rise

If piston rings and valves are in good condition, the first compression stroke shows the highest pressure increase. During the following compression strokes the compression builds up to the maximum pressure.

2. Gradual pressure rise

If, from the start, the compression increases only gradually on each piston stroke, this points to burnt valve seats or defective valve guides.

3. Low maximum pressure

If the maximum compression obtained is too low on all cylinders, this points to defective pistons, piston rings or valves.

If the compression is too low on two neighbouring cylinders, this points to a leaky cylinder head gasket.



4. Varying compression

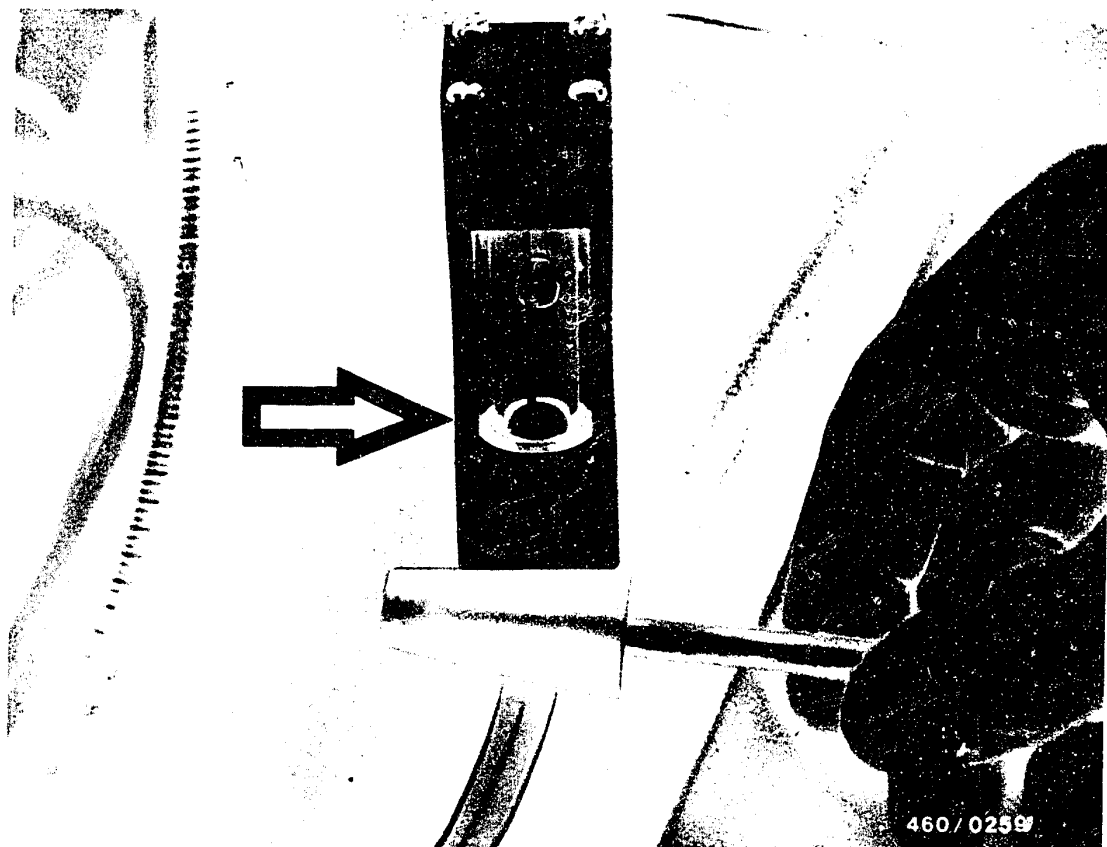
If one cylinder shows a clearly lower compression, proceed as follows: Fill in 2 - 3 cm³ of engine oil through the opening of the sheathed-element glow plug or nozzle holder and operate starting motor briefly.

Repeat measurements and compare charts. If there is a clear increase in compression during the second test, then the piston rings or cylinders are worn. If there is no change in the result, then defective valves are the cause.

5. Uniform compression

Uniform compression is extremely important with regard to the smooth running of the engine. Maximum compression is, therefore, not the only objective.





25.2 Measuring the compression loss of the engine

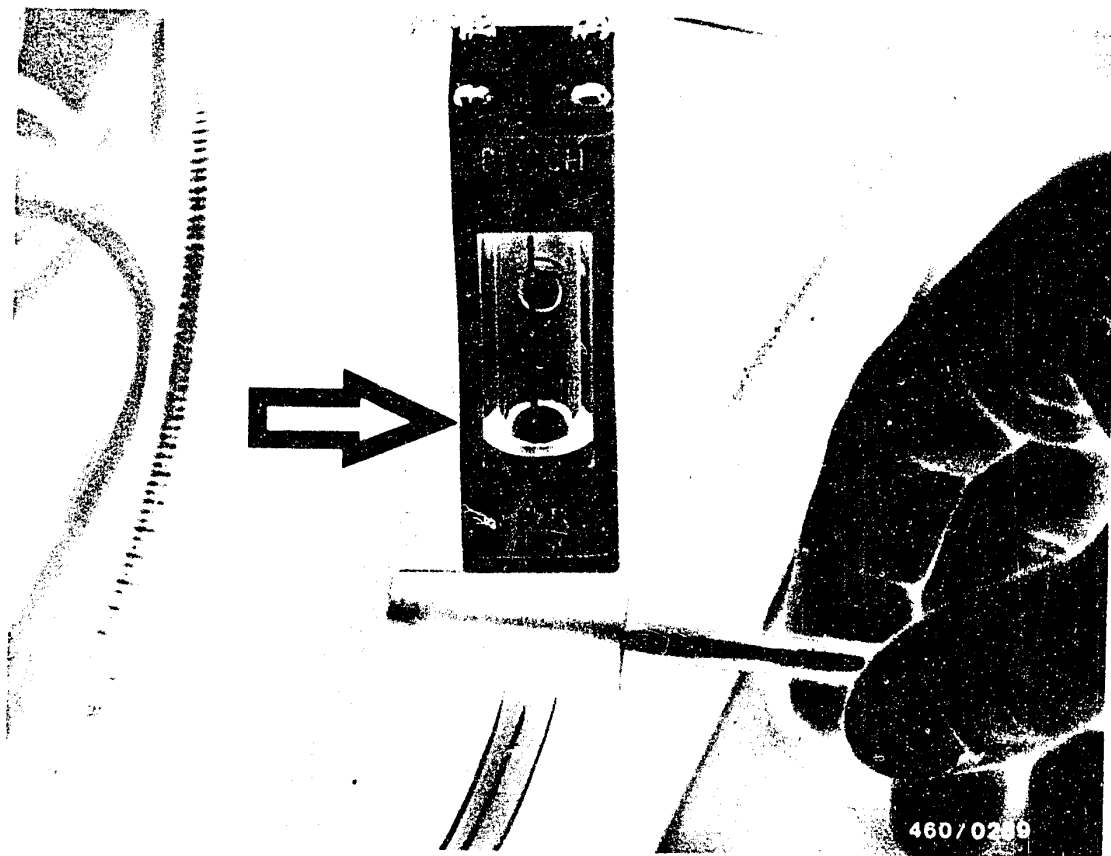
The test is performed using the BOSCH compression-loss tester 0 681 001 901 (EFAW 210 A).

For testing, the respective piston must be at TDC (TDC = top dead centre) on the compression stroke.

For setting this position, use DC detector 1 688 132 025 (included in accessories with compression-loss tester).

Perform test with engine at normal operating temperature (temperature of water approx. 80°C).





25.2.1 Set top dead centre

Remove sheathed-element glow plug from cylinder 1.

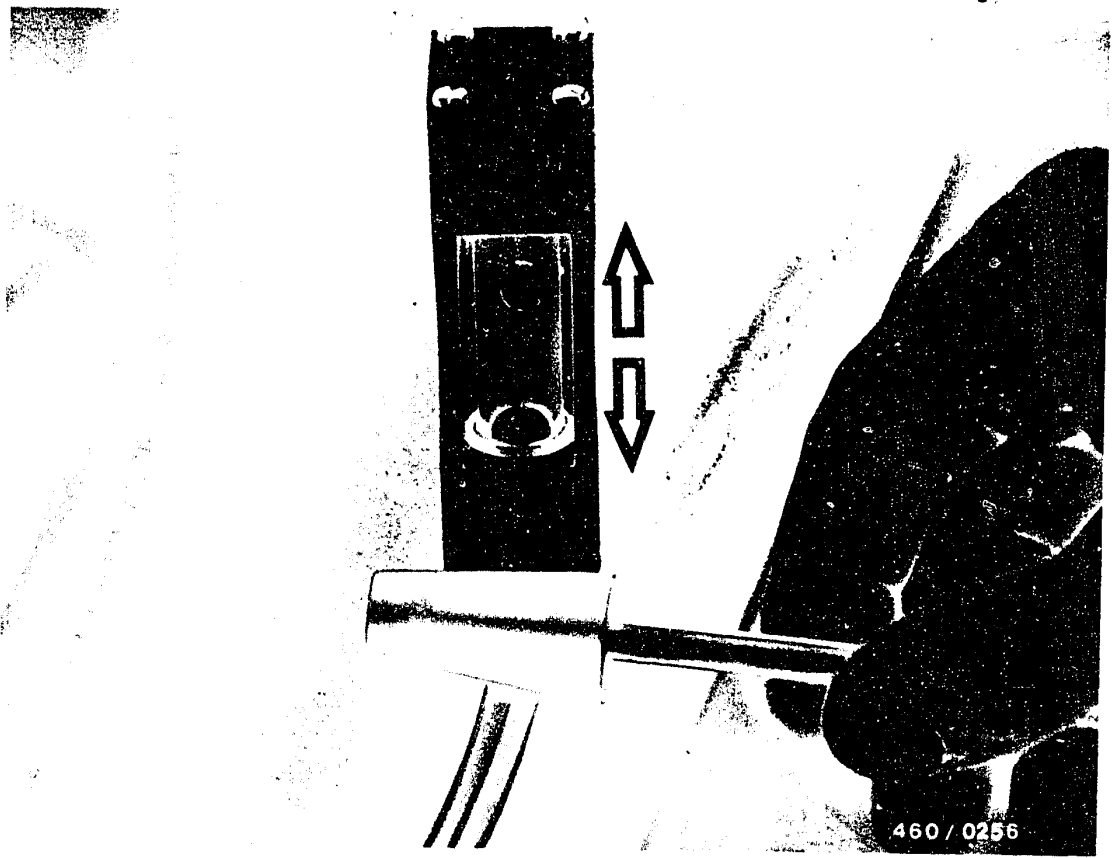
Insert rubber plug of DC detector into bore for sheathed-element glow plug.

Using magnetic clamp, mount glass cylinder in as vertical a position as possible in the engine compartment.

The piston of the unit must be easily visible.

Slowly turn the engine over by hand in its direction of rotation. (If necessary, select gear and push vehicle).





On the compression stroke, the piston of the DC detector is forced upwards.

As top dead centre is passed over, the piston slides down again immediately.

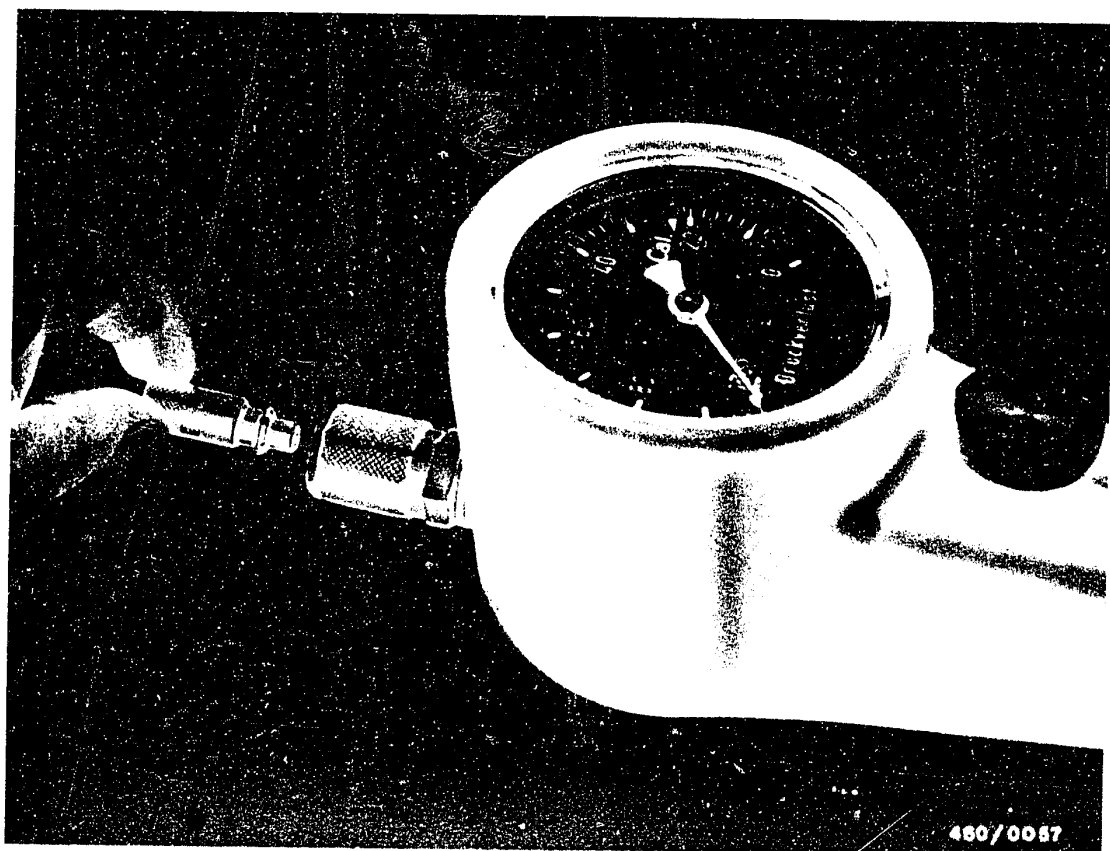
Locate top dead centre by carefully turning the engine backwards and forwards.

F4

Measuring engine comp. and comp. loss

Mercedes-Benz 190 D





25.2.2 Measuring compression loss

Connect tester to compressed-air mains.

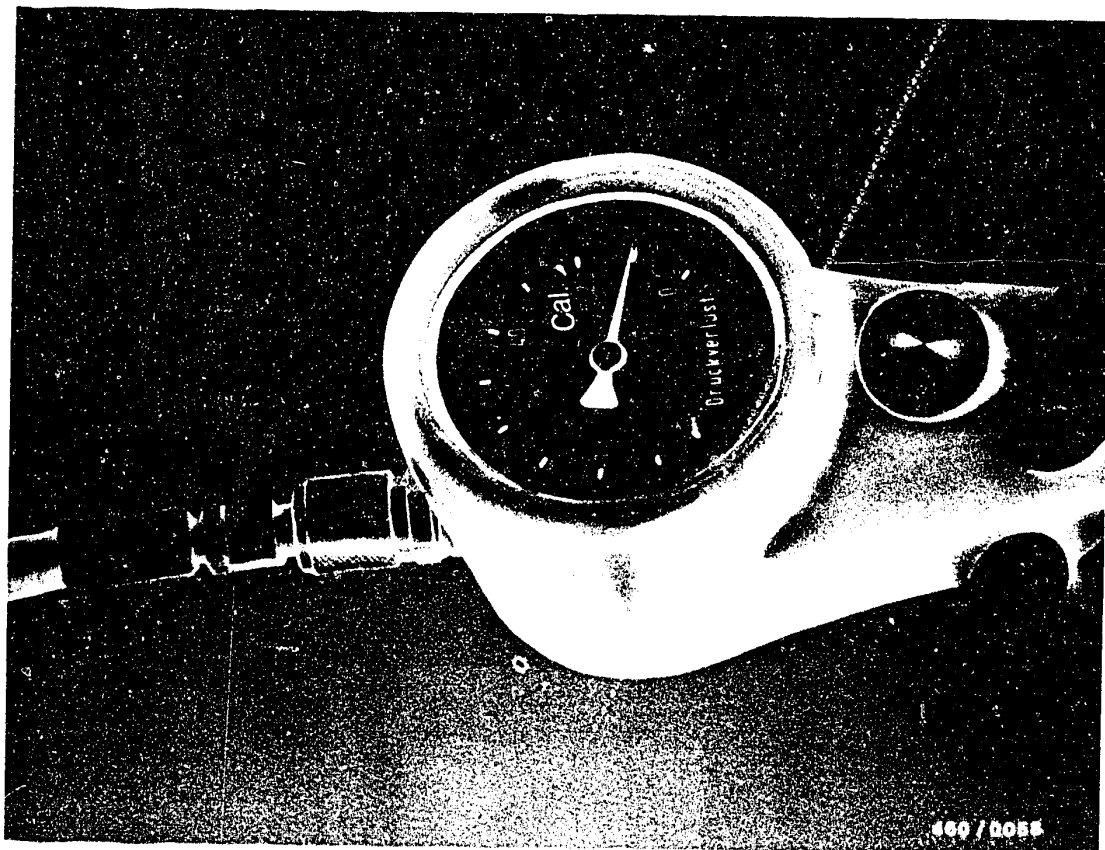
Connect calibrating nozzle 1 680 363 036. Set a compression loss of $23 \pm 1\%$ (marking "Cal") at the knurled thumbscrew on the pressure-regulating valve.

Disconnect calibrating nozzle.

Instrument indicator must show approximately 0% compression loss (equipment check).

Remove sheathed-element glow plug.





Nozzle-holder assemblies removed. Screw connecting nipple into opening of nozzle-holder assembly. Screw in fitting and mount test hose. Select gear and pull on handbrake. Connect test hose to tester. Read off compression lost in % on instrument.

Note:

Before testing the next cylinder, turn the engine over briefly without preheating using the starting motor so that the oil film re-forms.

F6

Measure engine comp. and comp. loss

Mercedes Benz 190 D



25.2.3 Evaluation of test

The compression loss indicated should not exceed 25%.

Differences of 10% between the individual cylinders can be ignored.

The causes of greater losses can be located because the air makes a noise as it escapes.

Listen at the following points:

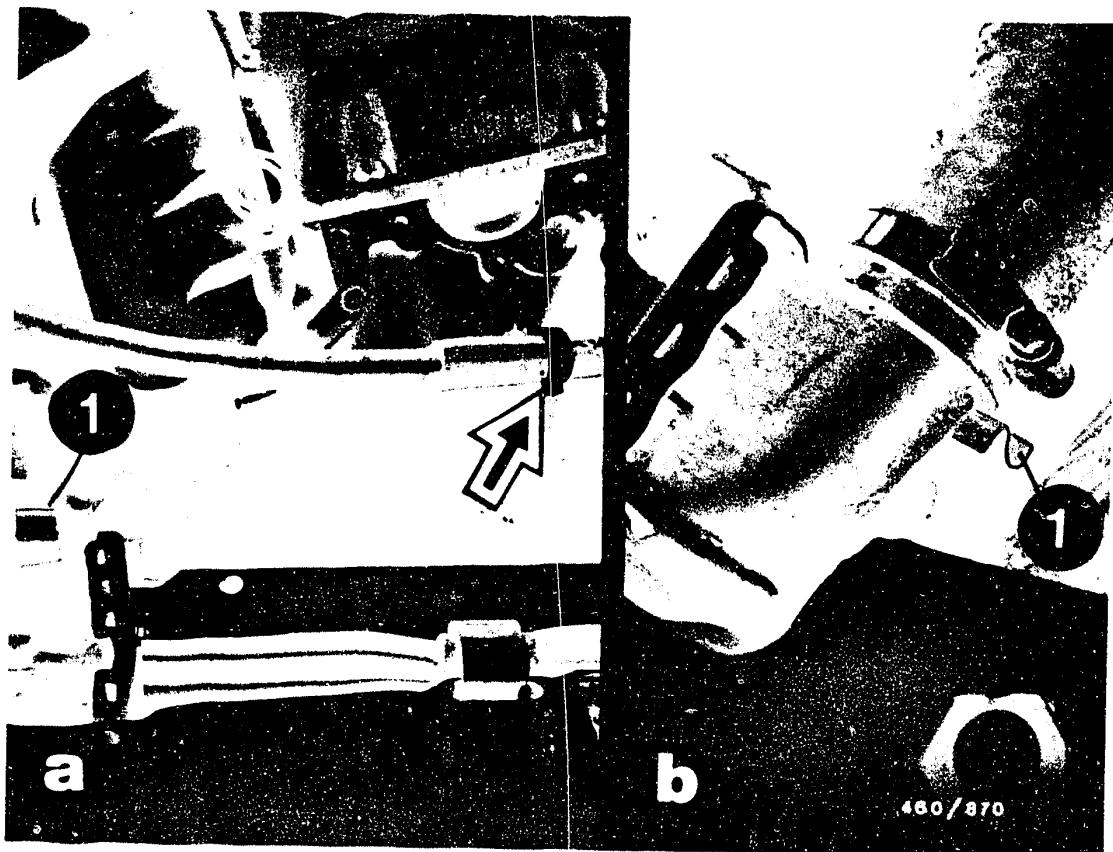
<u>Location of noise</u>	<u>Possible trouble</u>
Intake manifold (remove air filter)	Intake valve
Exhaust manifold	Exhaust valve
Oil filler neck on engine	Pistons, piston rings
Cooling water filler neck (air bubbles)	Cylinder head gasket

In order to trace the trouble even more accurately, fill approximately 2-3 cm³ of engine oil into the cylinder. Repeat test.

If there is a clear decrease in compression loss during this test, then the fault lies with the piston or with the piston rings.

New engines which have not yet been run in (less than 5000 km) may show higher compression losses than after the running-in period.





1 = Fan shrouds

26. Work on fuel-injection pump

26.1 Remove fuel-injection pump

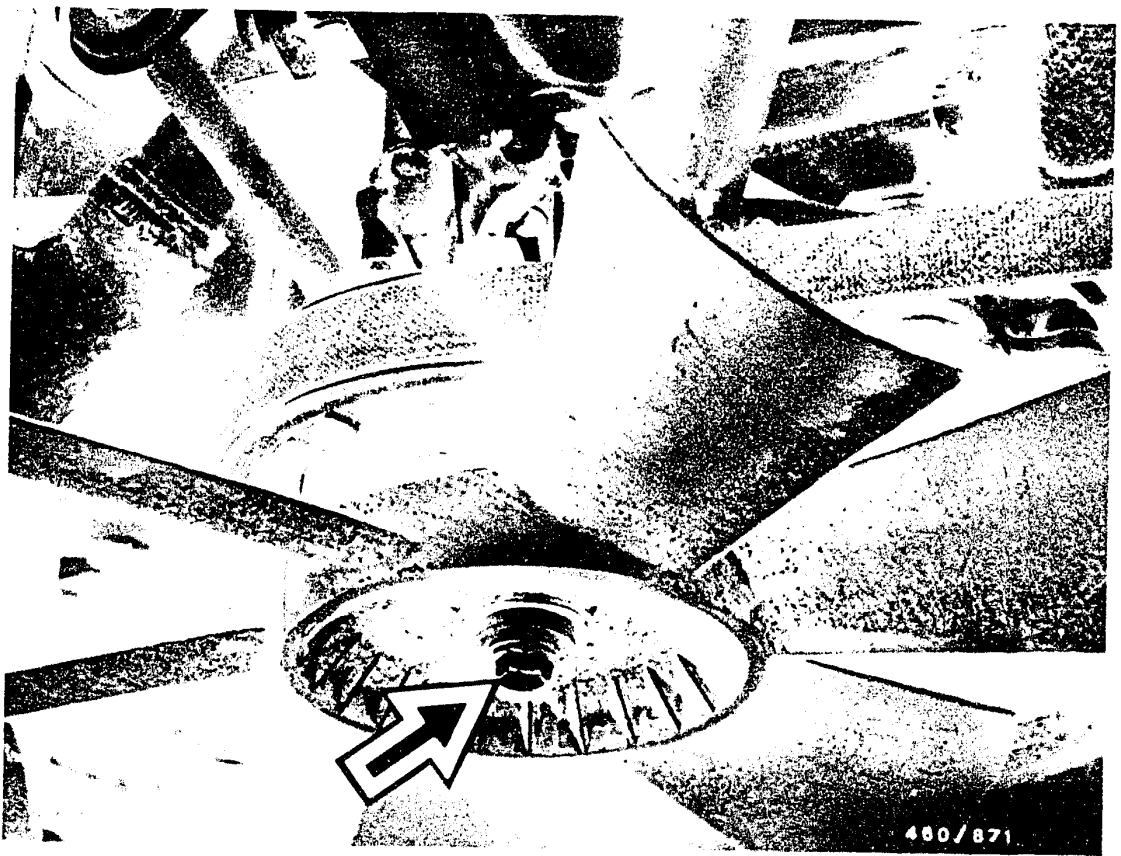
Disconnect negative cable from battery.
Remove fan shrouds (see pictures a and b) and hose binder (arrow, picture a).

F8

Remove fuel-injection pump

Mercedes Benz 190 D



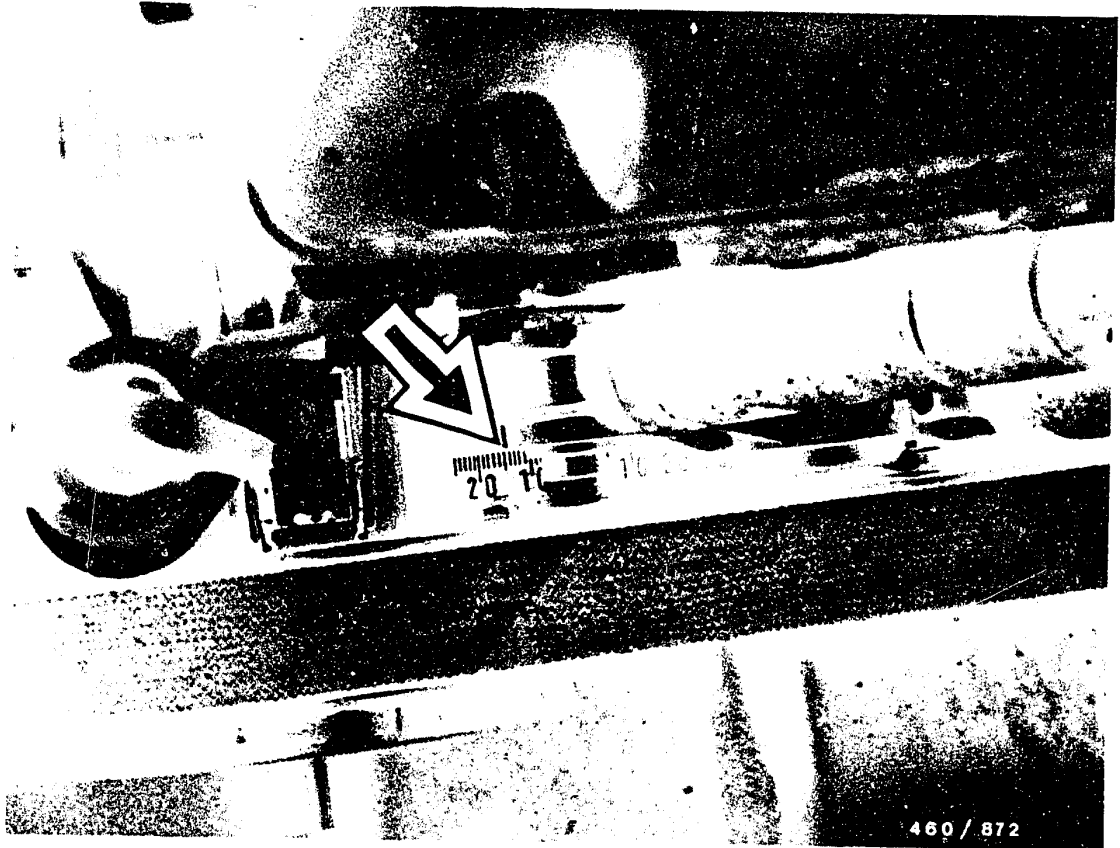


Unscrew fan fastening screw (arrow).
Remove fan and fan cover on radiator.
Remove front noise capsule.

F9

Remove fuel-injection pump
Mercedes Benz 190 D





460 / 872

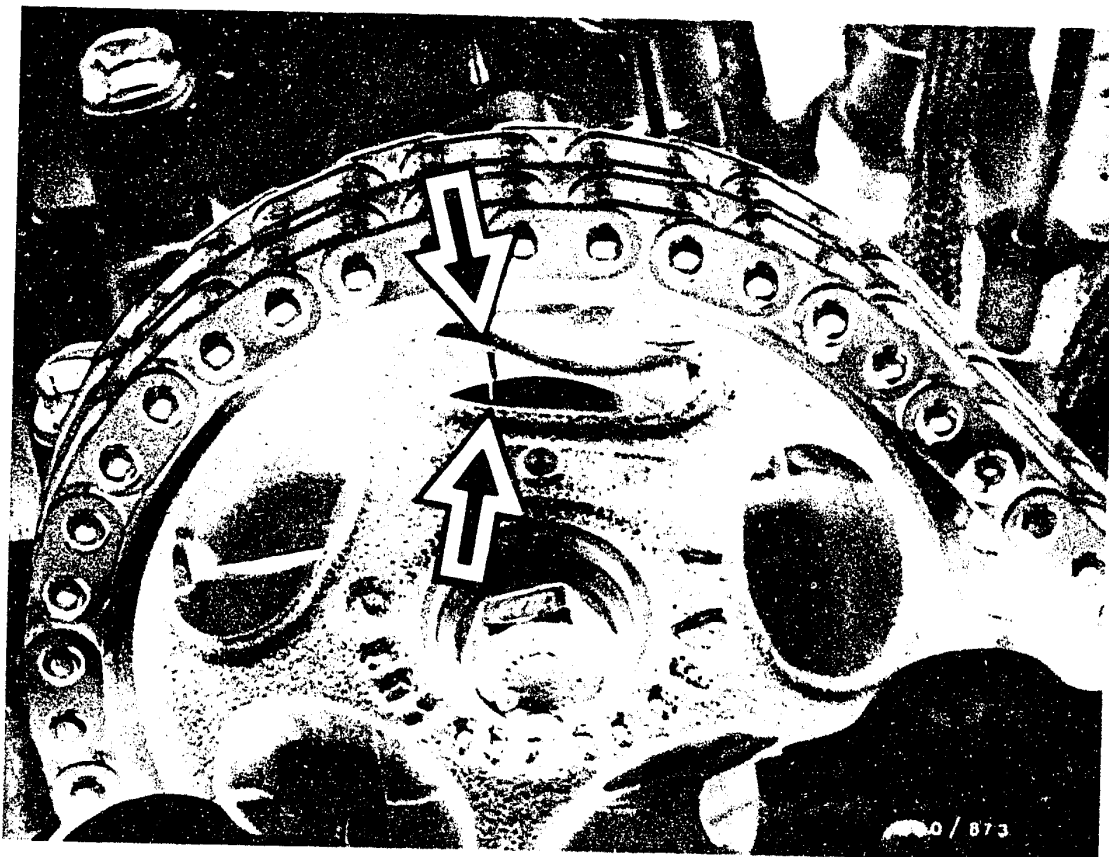
Turn crankshaft in engine direction of rotation to 15° ATDC on cylinder 1 (see picture, arrow).

F10

Remove fuel-injection pump

Mercedes Benz 190 D





Note:

With the piston of cylinder 1 at TDC, the notch on the front collar of the camshaft must align with the rib on the 1st camshaft bearing (see picture, arrows).

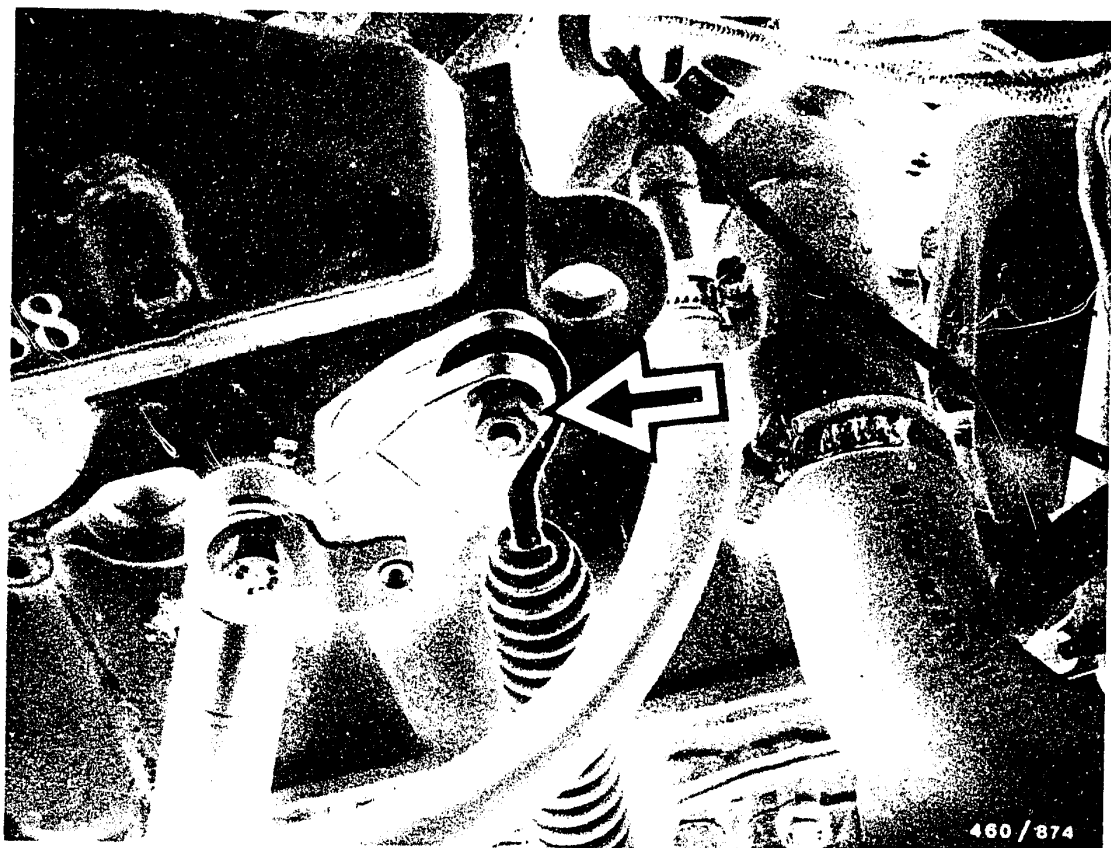
Valves of cylinder 4 are on overlap. (Visible after removing the cylinder head cover).

F11

Remove fuel-injection pump

Mercedes Benz 190 D



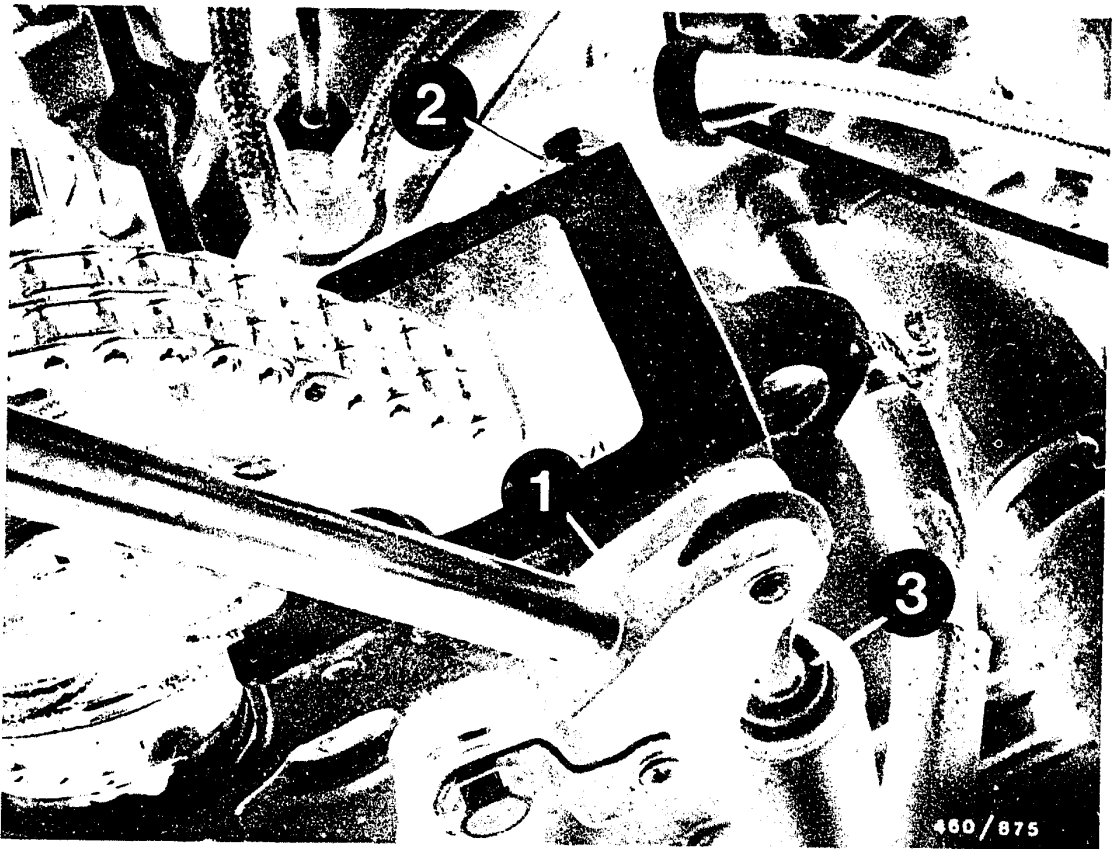


Unscrew belt tensioner fastening nut (see picture, arrow).

F12

Remove fuel-injection pump
Mercedes Benz 190 D





- 1 = Spring tensioning lever
- 2 = Fastening screw
- 3 = Extension spring

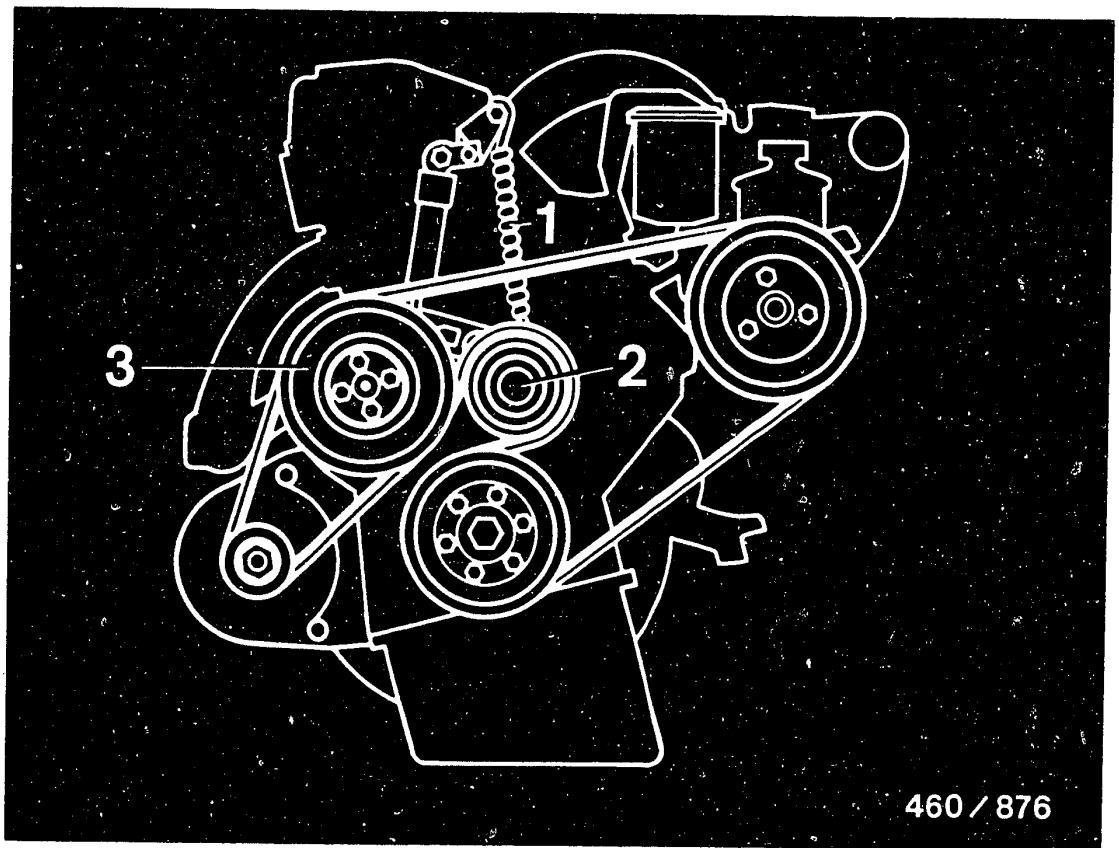
Stick lever or mandrel (12 - 13 mm \emptyset , approx. 300 mm long) into bore on spring tensioning lever (1). Press lever slightly to the left until fastening screw (2) can be pushed back.

Relax extension spring (3). To do this, slowly pivot lever to the right.

F13

Remove fuel-injection pump
Mercedes Benz 190 D





460 / 876

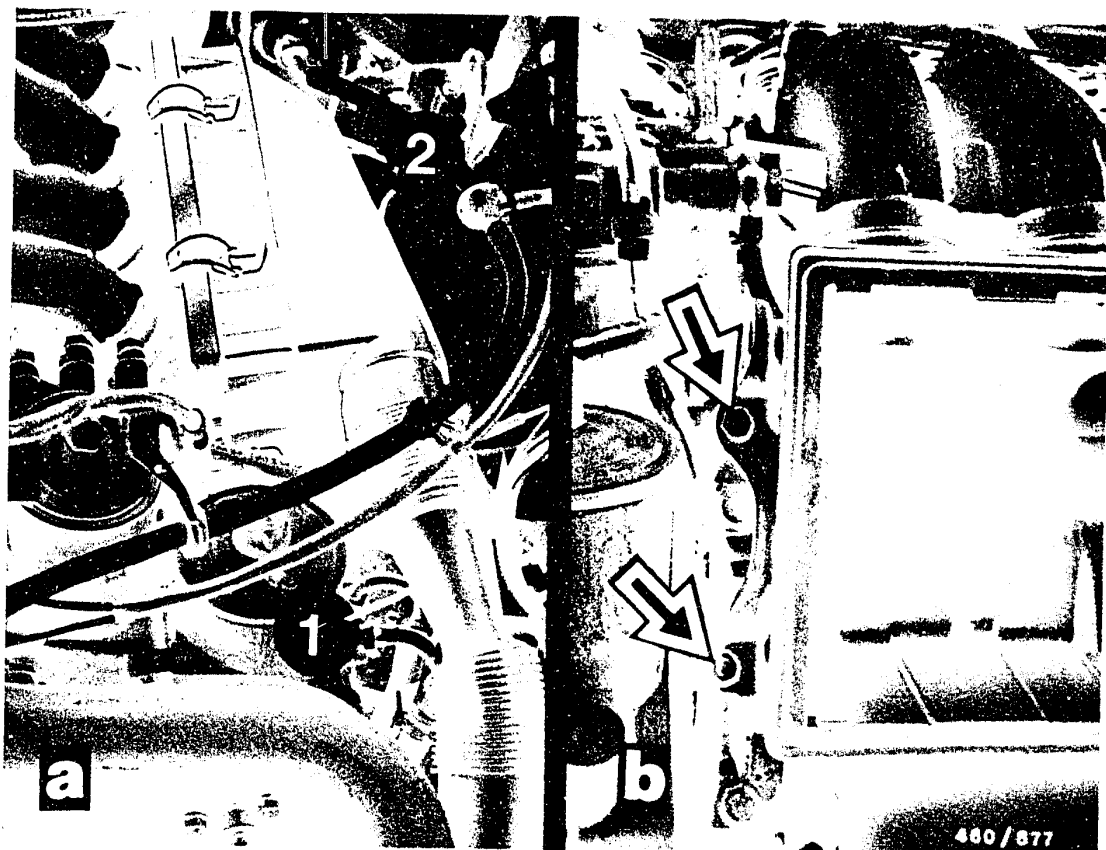
- 1 = Extension spring
- 2 = Tensioning roller
- 3 = Coolant pump

Unhook extension spring from tensioning roller.
Push back tensioning roller and take off ribbed V-belt.

F14

Remove fuel-injection pump
Mercedes Benz 190 D



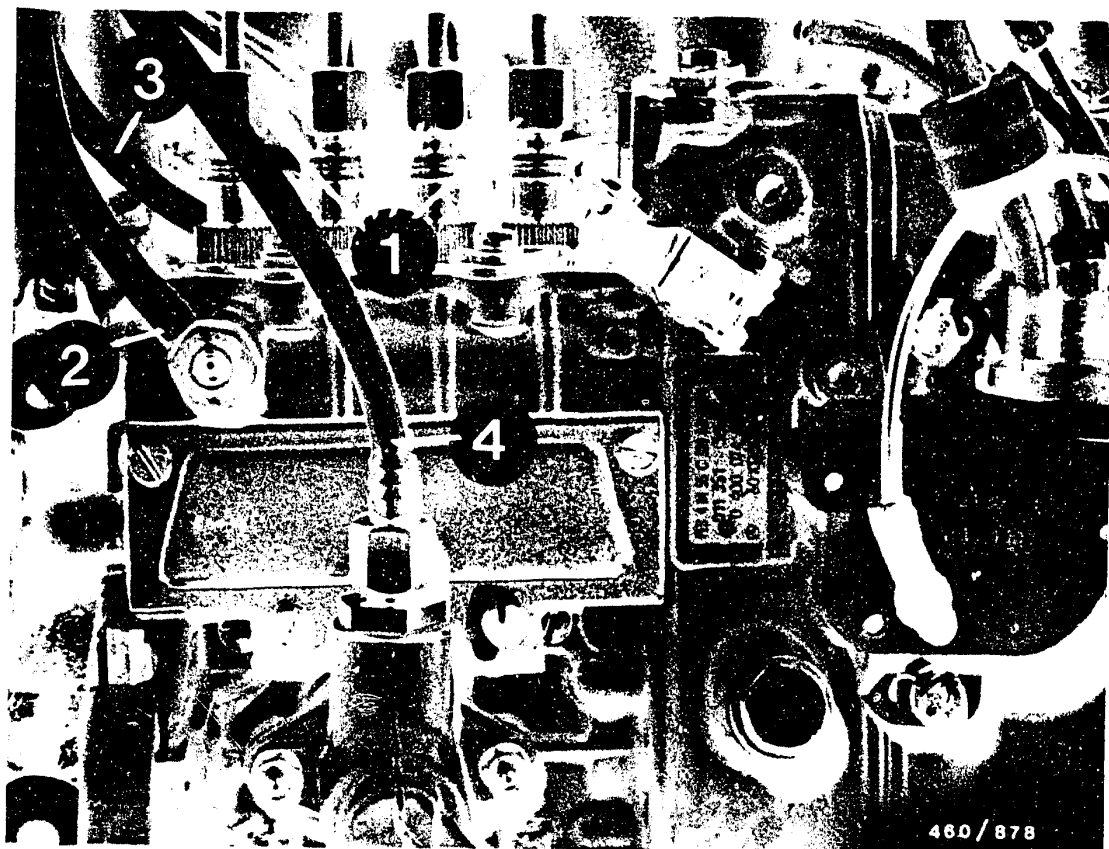


- 1 = Air-intake dome
2 = Air filter cover

Remove air-intake dome and air filter cover (loosen 6 fastening clamps).

Remove the fastening nuts of the side holders for air guide housing (see picture, arrows).





- 1 = Injection lines
- 2 = Fuel inlet line
- 3 = Fuel return line
- 4 = Inlet line to fuel filter

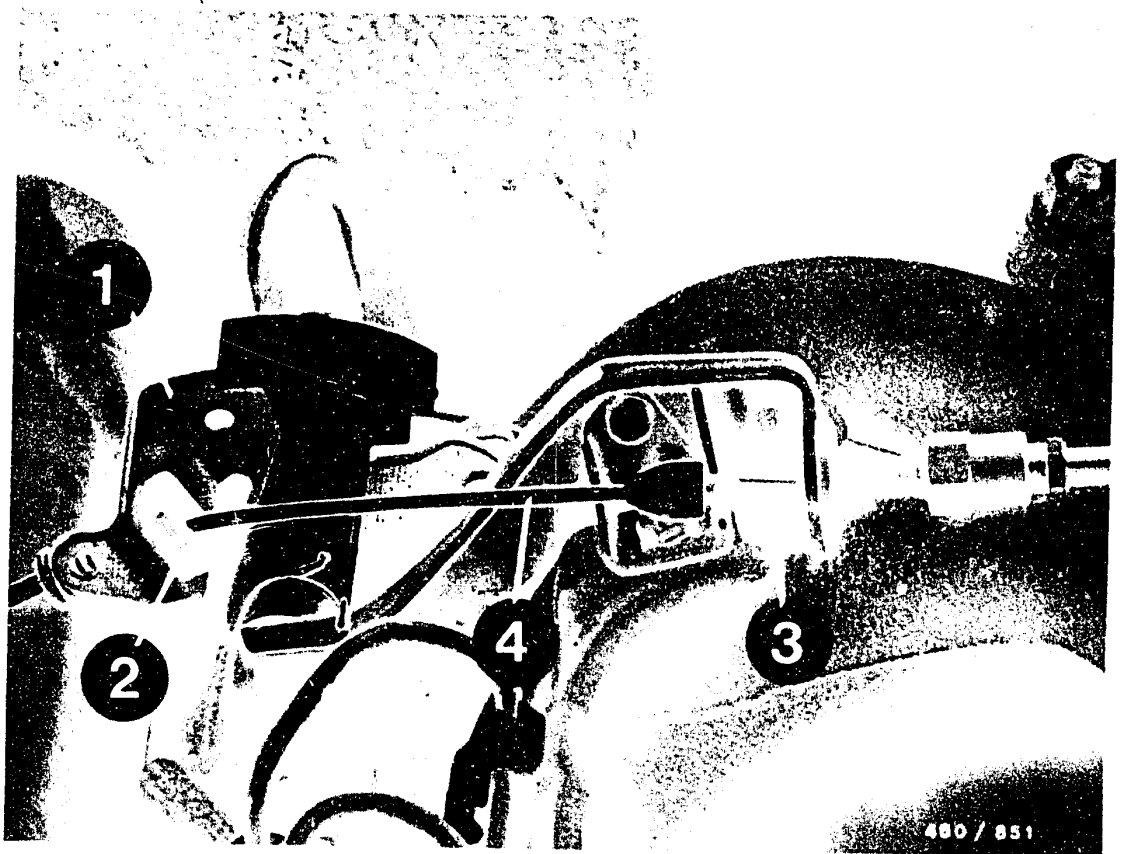
Loosen injection lines.
Unscrew fuel inlet line, fuel return line and inlet line
to fuel filter.

F16

Remove fuel-injection pump

Mercedes Benz 190 D





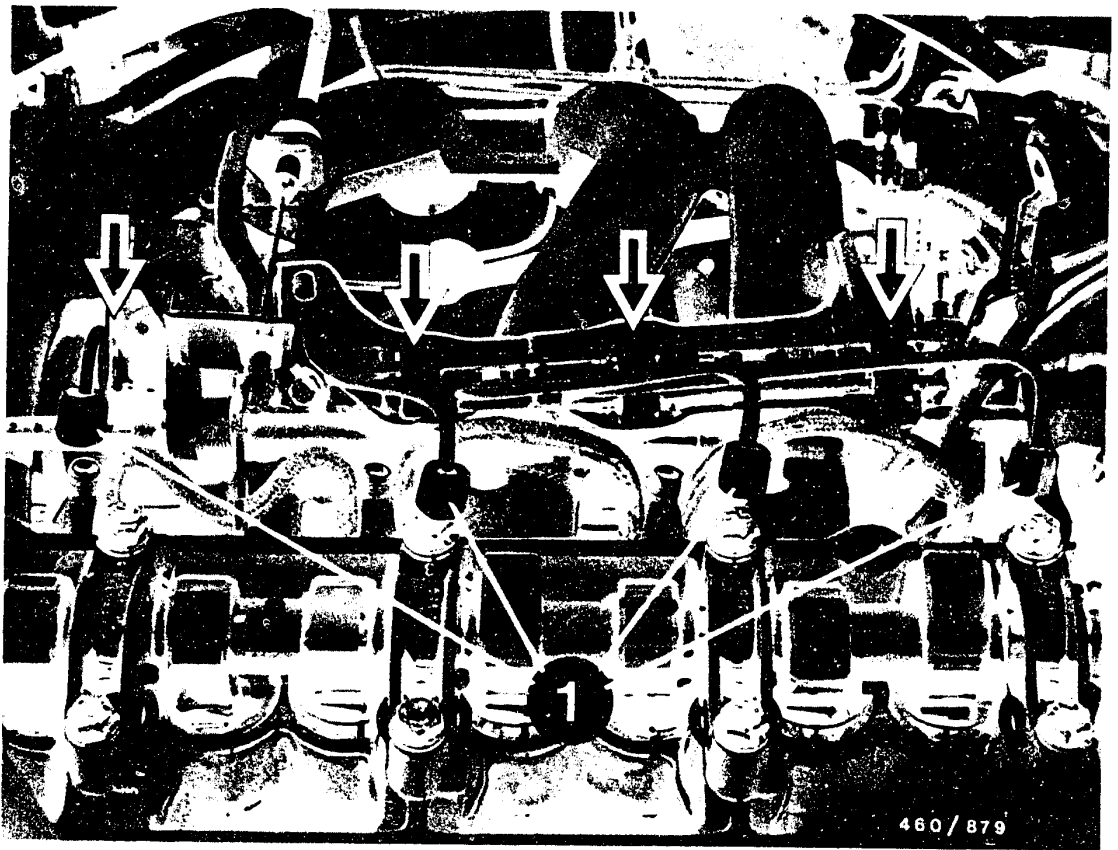
- 1 = Bell crank
- 2 = Guide piece
- 3 = Expansion clamp
- 4 = Cable

Press out slotted guide piece on bell crank.
Press together expansion clamp.
Unhook cable and place to one side.

F17

Remove fuel-injection pump
Mercedes Benz 190 D





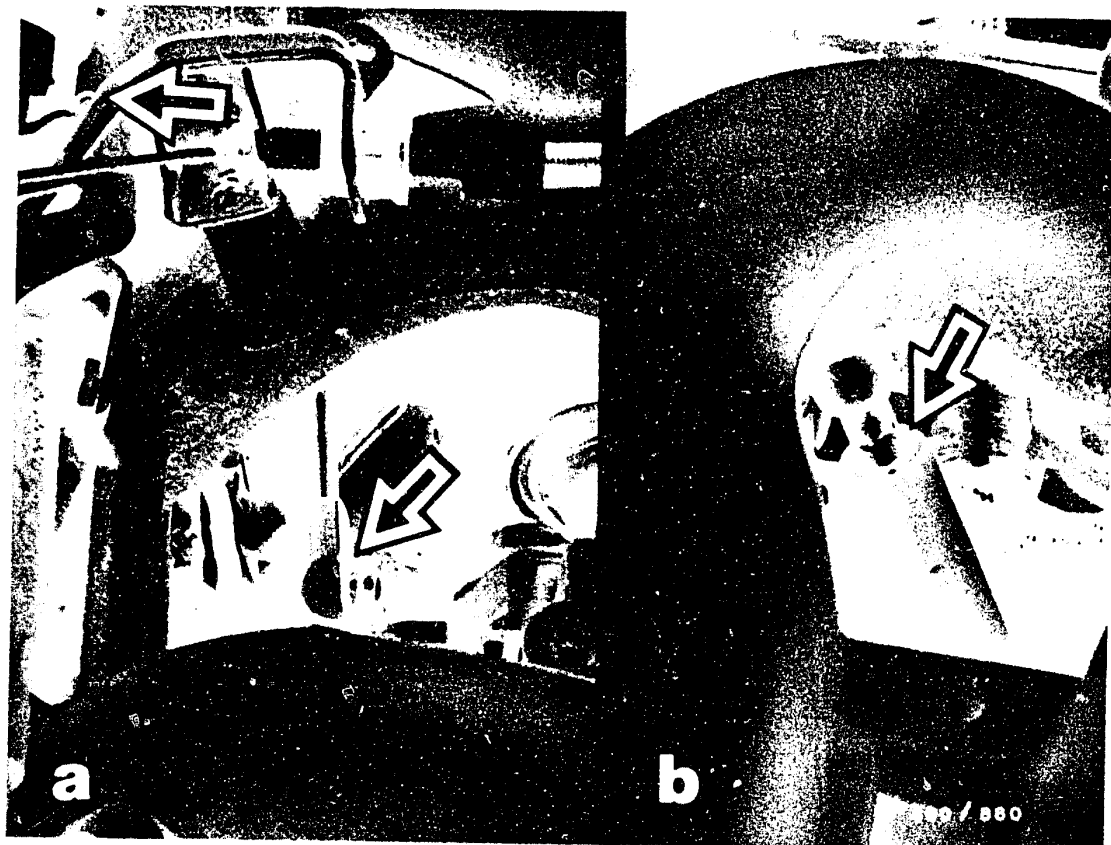
1 = Injection lines

Unscrew injection lines from nozzle-holder assemblies.
Remove fastening screws of injection lines and plastic
clip (see picture, arrows).

F18

Remove fuel-injection pump
Mercedes Benz 190 D





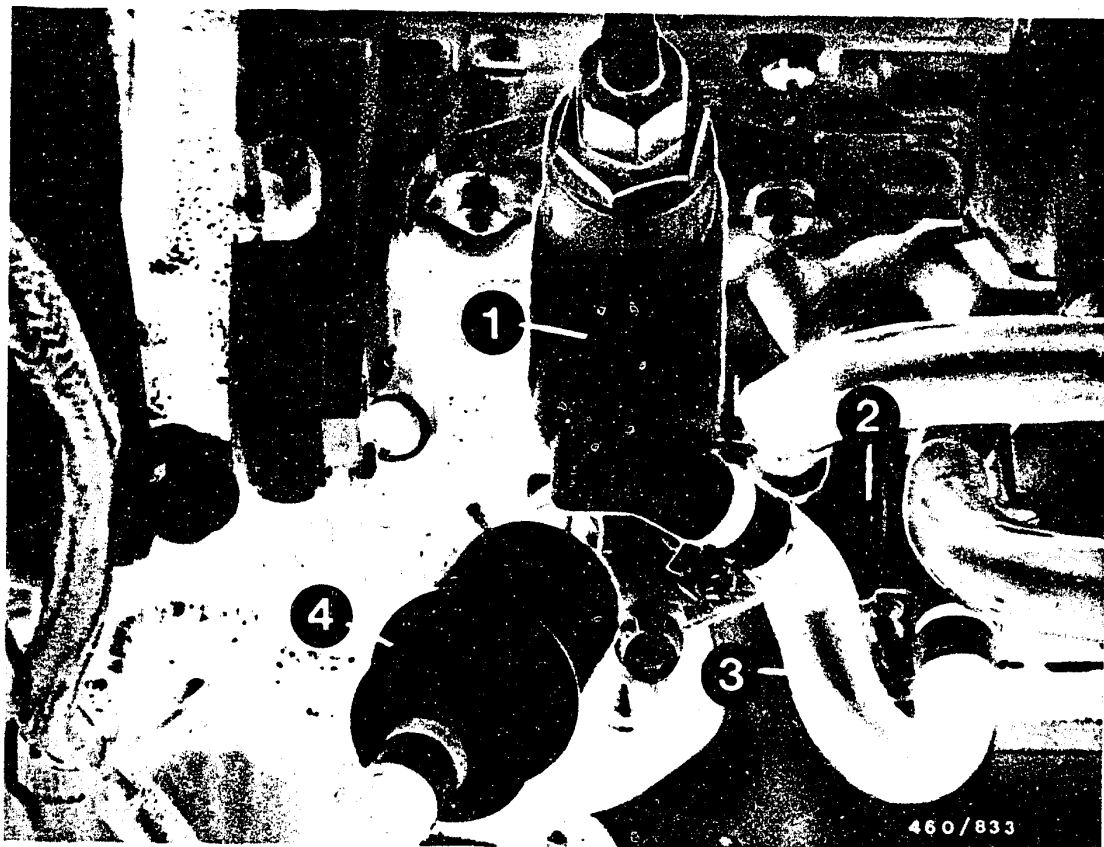
Unhook regulating linkage (arrows, picture a), damper (arrow, picture b).

F19

Remove fuel-injection pump

Mercedes Benz 190 D

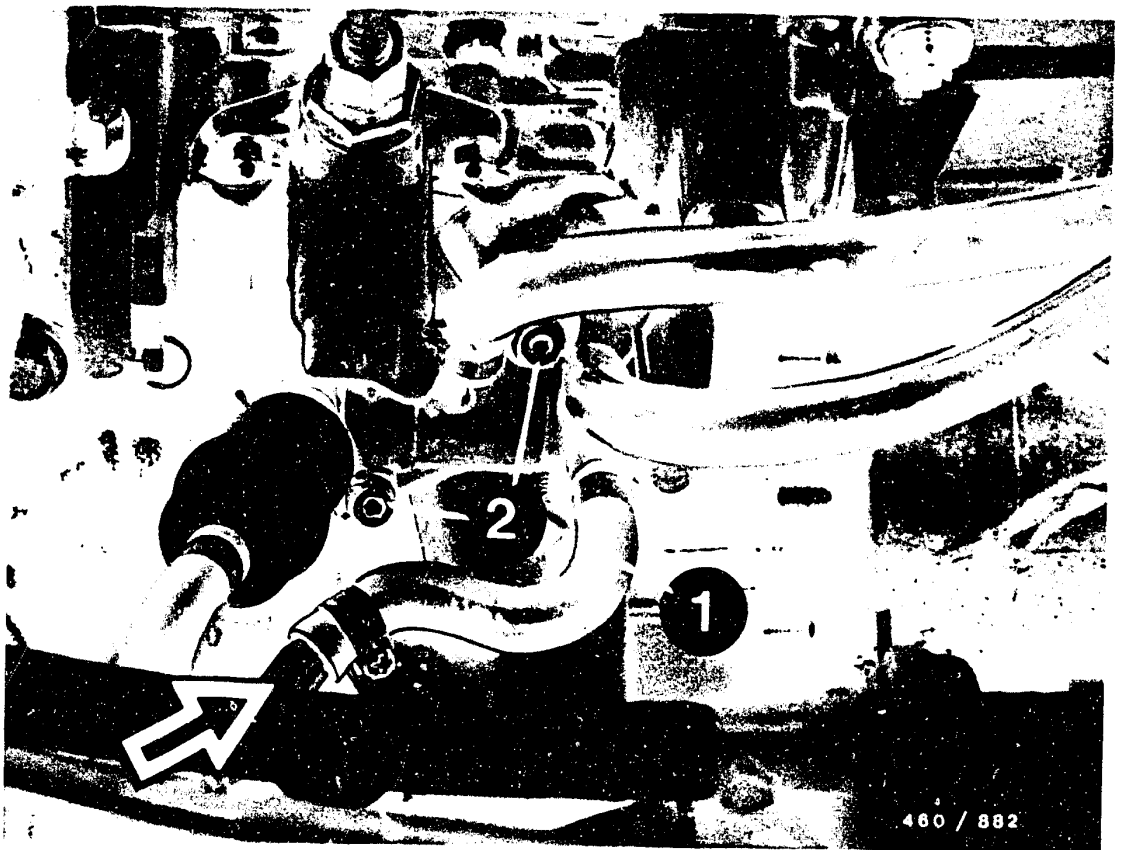




- 1 = Fuel supply pump
- 2 = Fuel thermostat
- 3 = Suction line
- 4 = Fuel prefilter

Unscrew suction line to fuel supply pump.





- 1 = Suction line
- 2 = Thermostat fastening screws

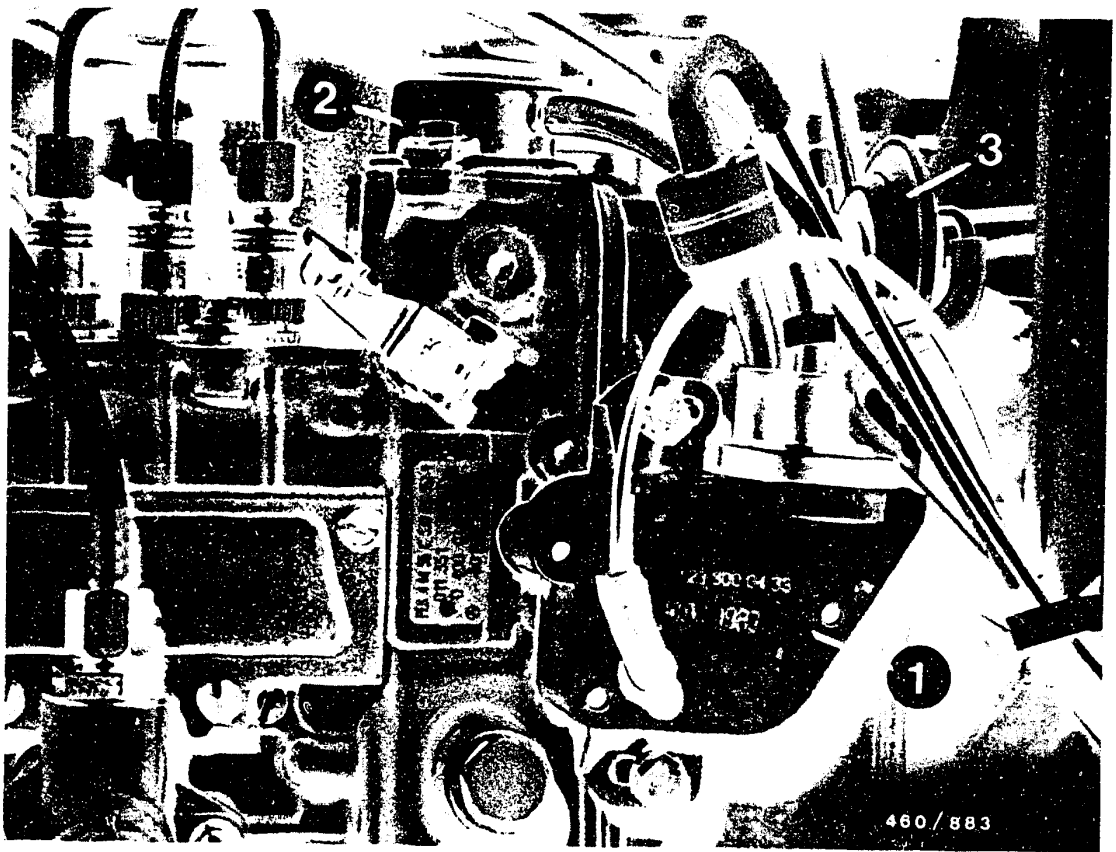
Close suction line with mandrel (arrow).
Unscrew fastening screws from fuel thermostat.

○

F21

Remove fuel-injection pump
Mercedes Benz 190 D





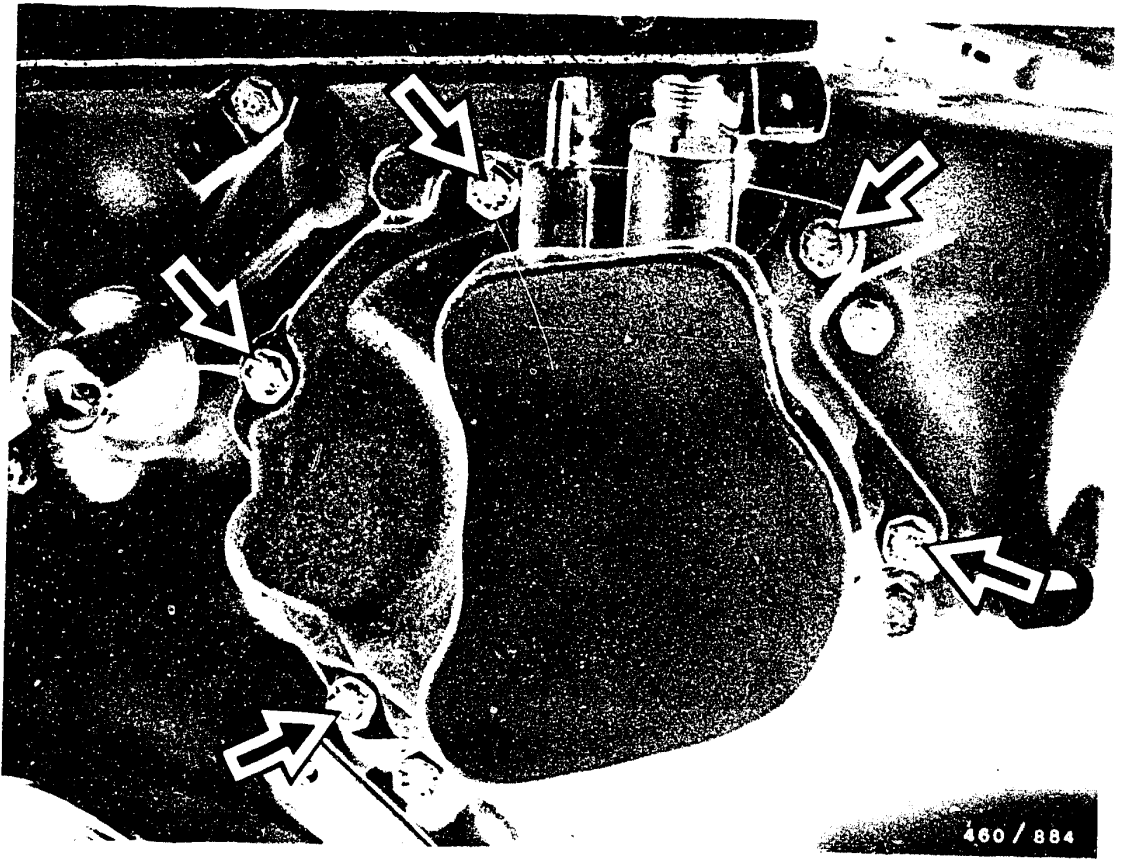
- 1 = Vacuum-control valve
- 2 = Shutoff box
- 3 = Vacuum unit

Disconnect vacuum lines from vacuum unit for idle increase, from shutoff box and, on vehicles with automatic transmission, from vacuum-control valve.

F22

Remove fuel-injection pump
Mercedes Benz 190 D



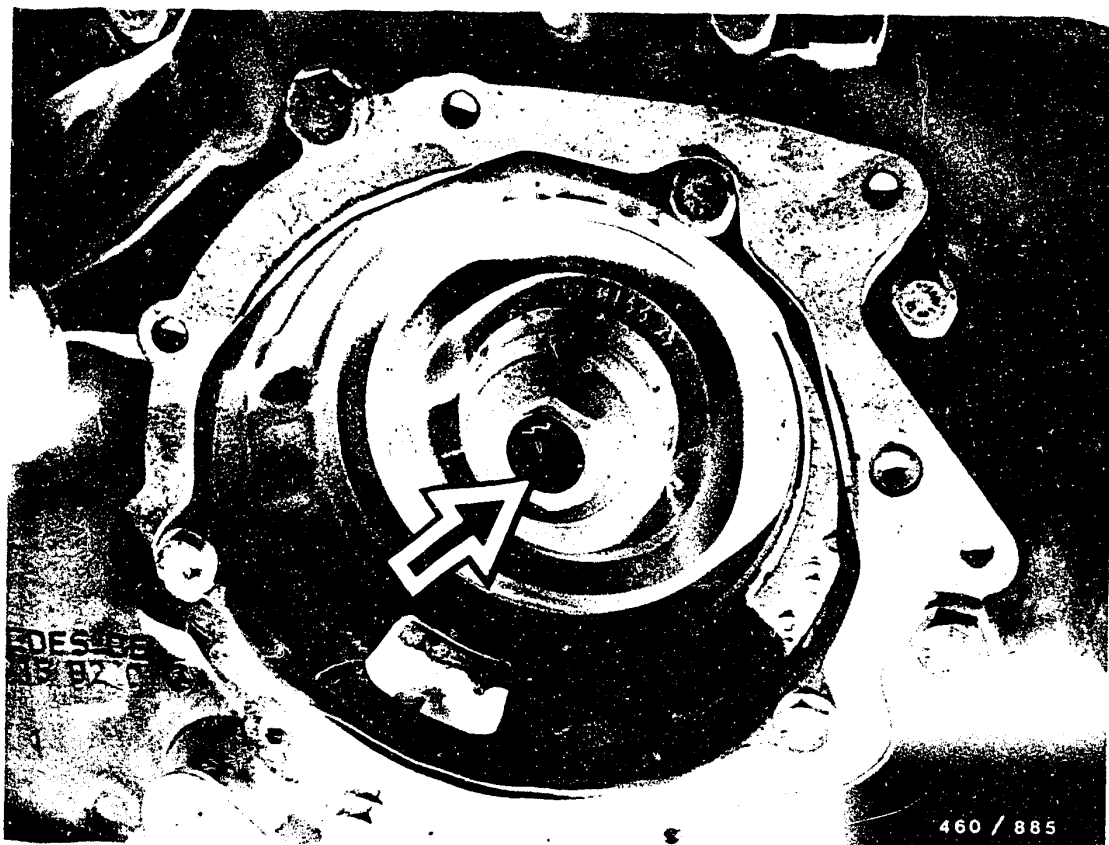


Remove vacuum pump fastening screws (see picture, arrows). Remove vacuum pump.

F23

Remove fuel-injection pump
Mercedes Benz 190 D





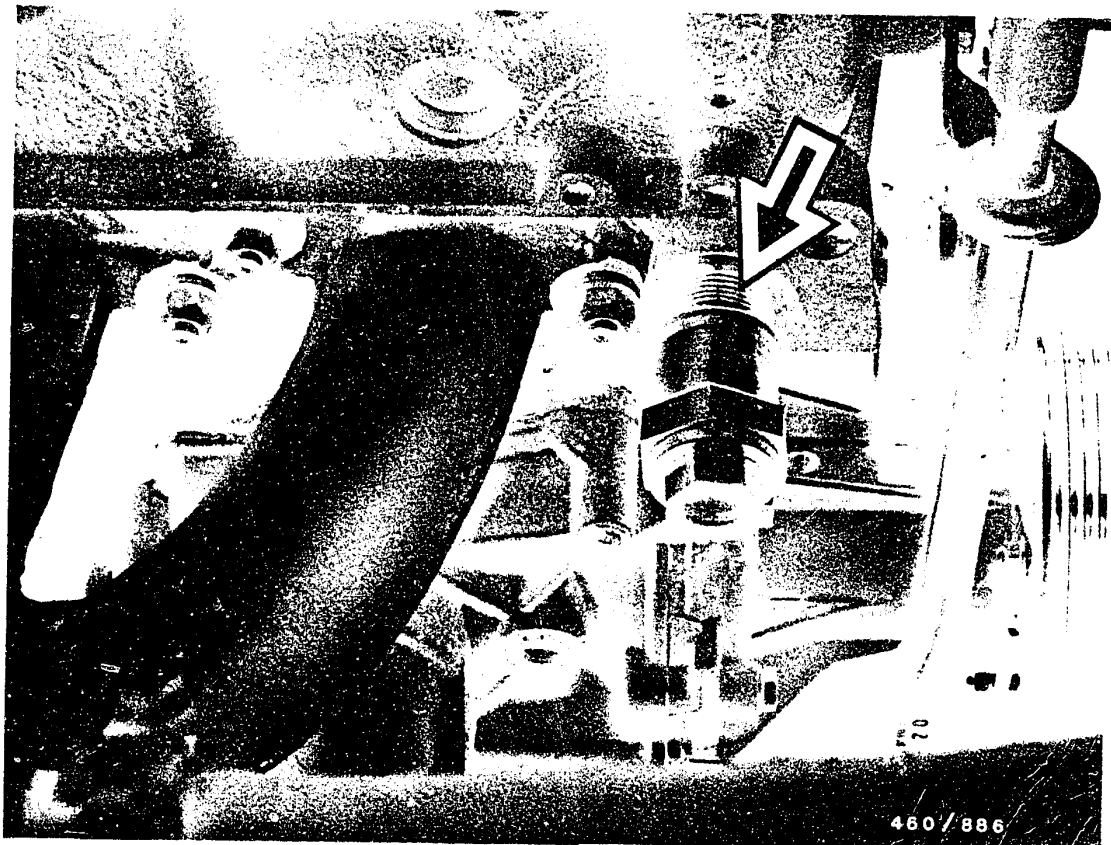
Only loosen central fastening screw of timing device
(see picture, arrow) (caution: LEFT-HAND THREAD)
To do this, hold the crankshaft to stop it from turning.

F24

Remove fuel-injection pump

Mercedes Benz 190 D



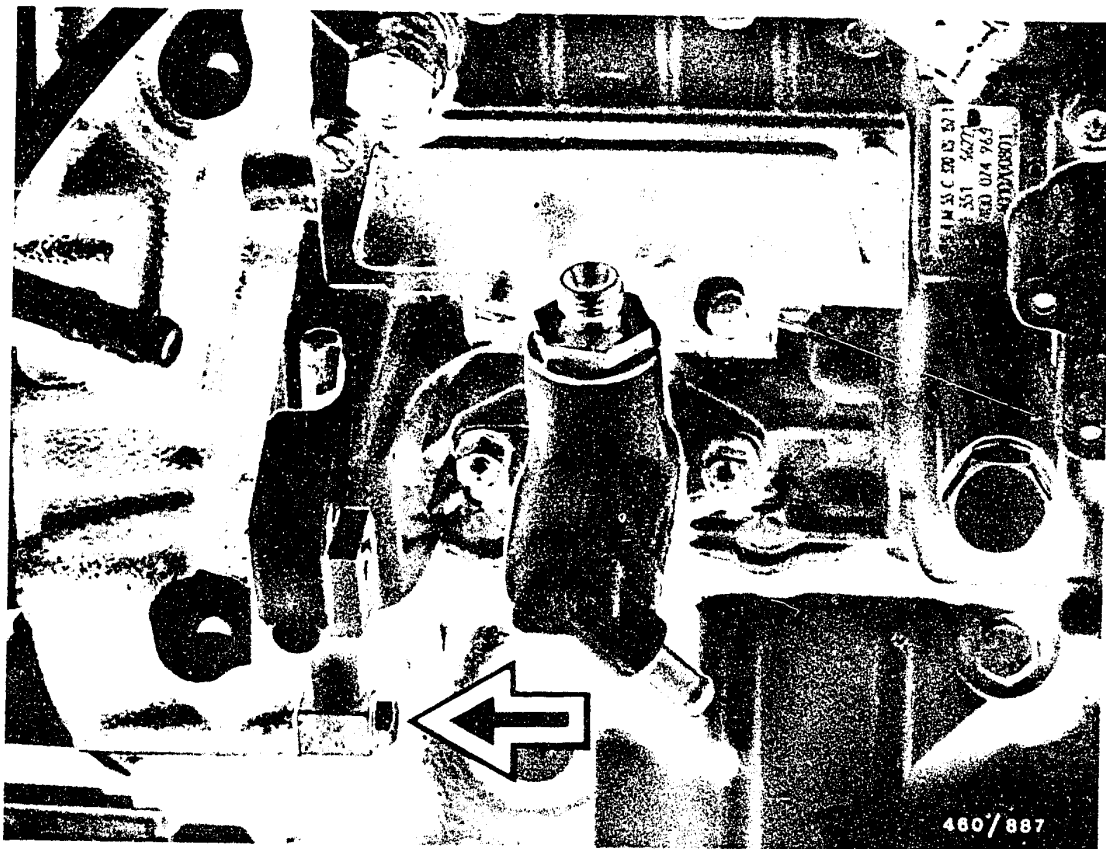


Loosen chain tensioner (see picture, arrow) (do not remove).

G1

Remove fuel-injection pump
Mercedes Benz 190 D





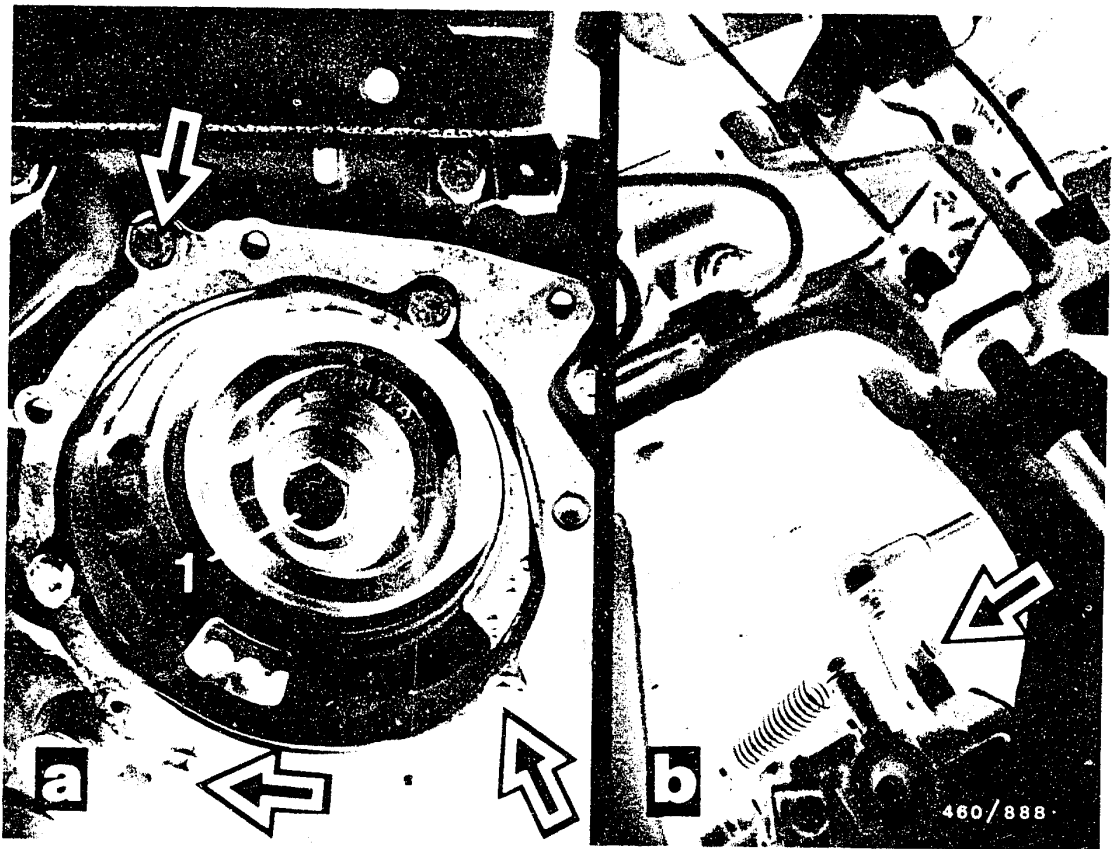
Only loosen setting device for setting the start of delivery (arrow). Do not remove fastening screw.

G2

Remove fuel-injection pump

Mercedes Benz 190 D





1 = Central fastening screws of timing device (left-hand thread)

Remove central fastening screw (left-hand thread).
 Remove injection-pump fastening screws at drive end (arrows - picture a) and on support bracket (arrow, picture b).

Withdraw injection pump toward the rear.

Note:

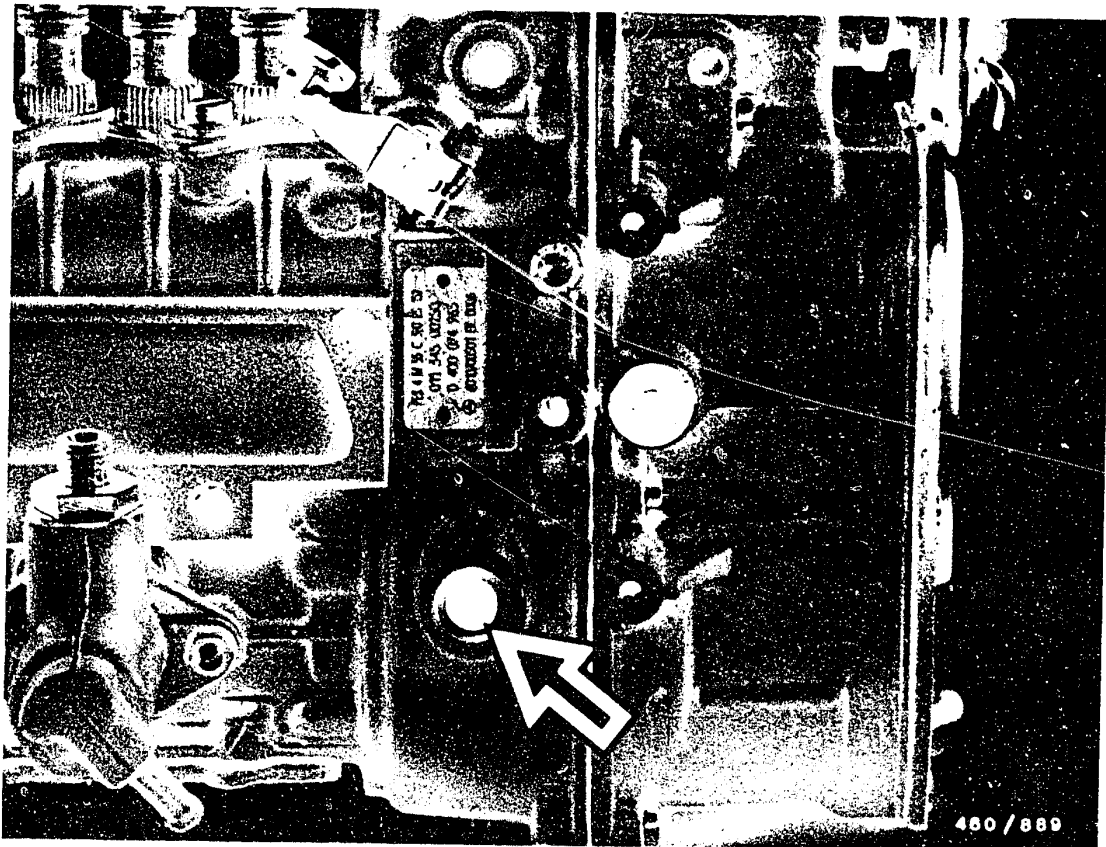
Do not change position of installed timing device.

G3

Remove fuel-injection pump

Mercedes Benz 190 D





27. Install fuel-injection pump

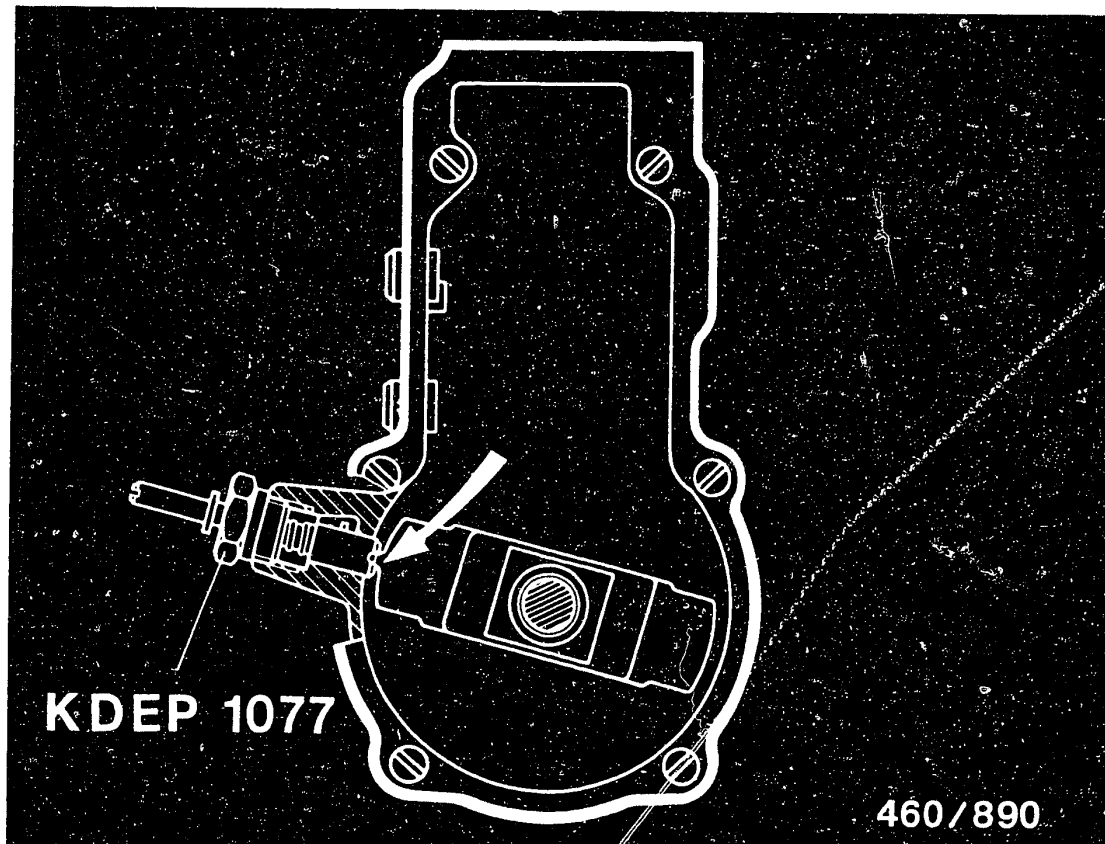
27.1 Preparations

Remove screw plug (arrow) (already removed in picture).
Do not yet introduce injection pump into engine.

G4

Install fuel-injection pump
Mercedes Benz 190 D





Turn injection-pump camshaft with drive coupling until the lug (see picture, arrow) of the governor is visible at the bore.

In this position, insert holding device KDEP 1077 until it can be felt to latch.

Tighten nut by hand.

Note:

Danger of damage to injection pump.

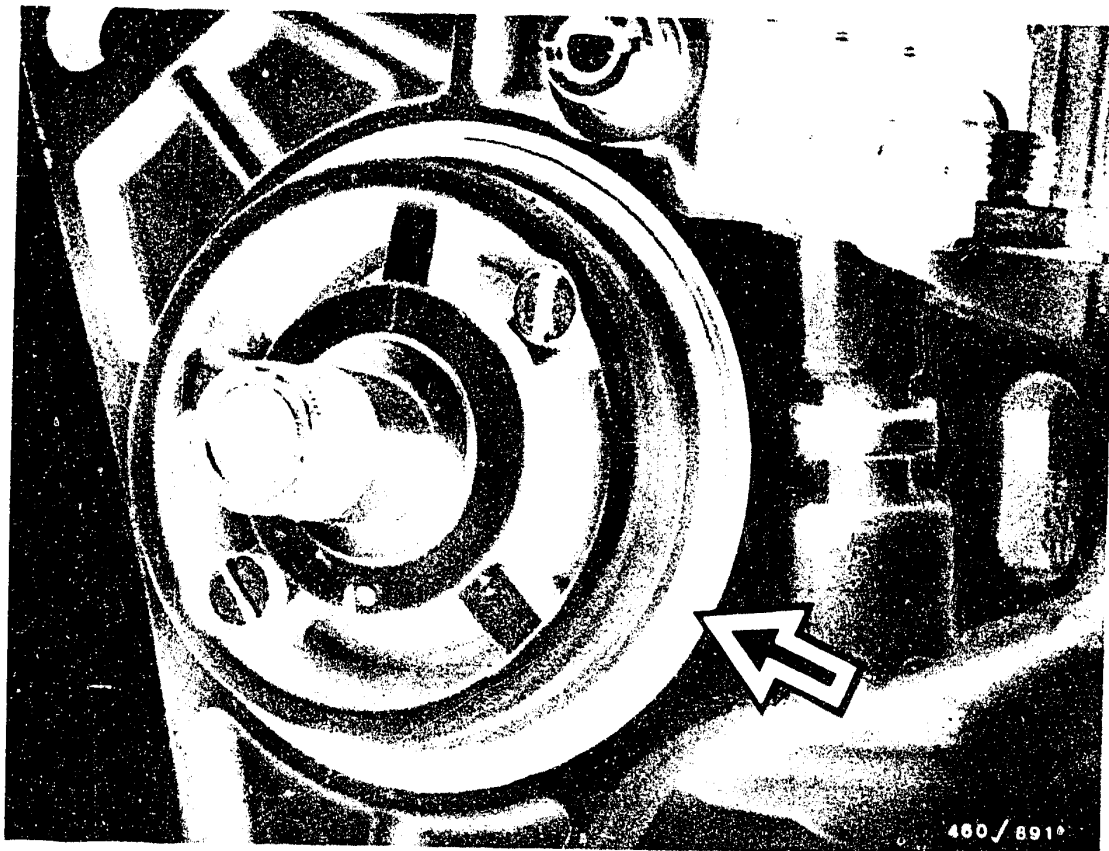
Immediately after installing the injection pump, remove holding device KDEP 1077.

G5

Install fuel-injection pump

Mercedes Benz 190 D





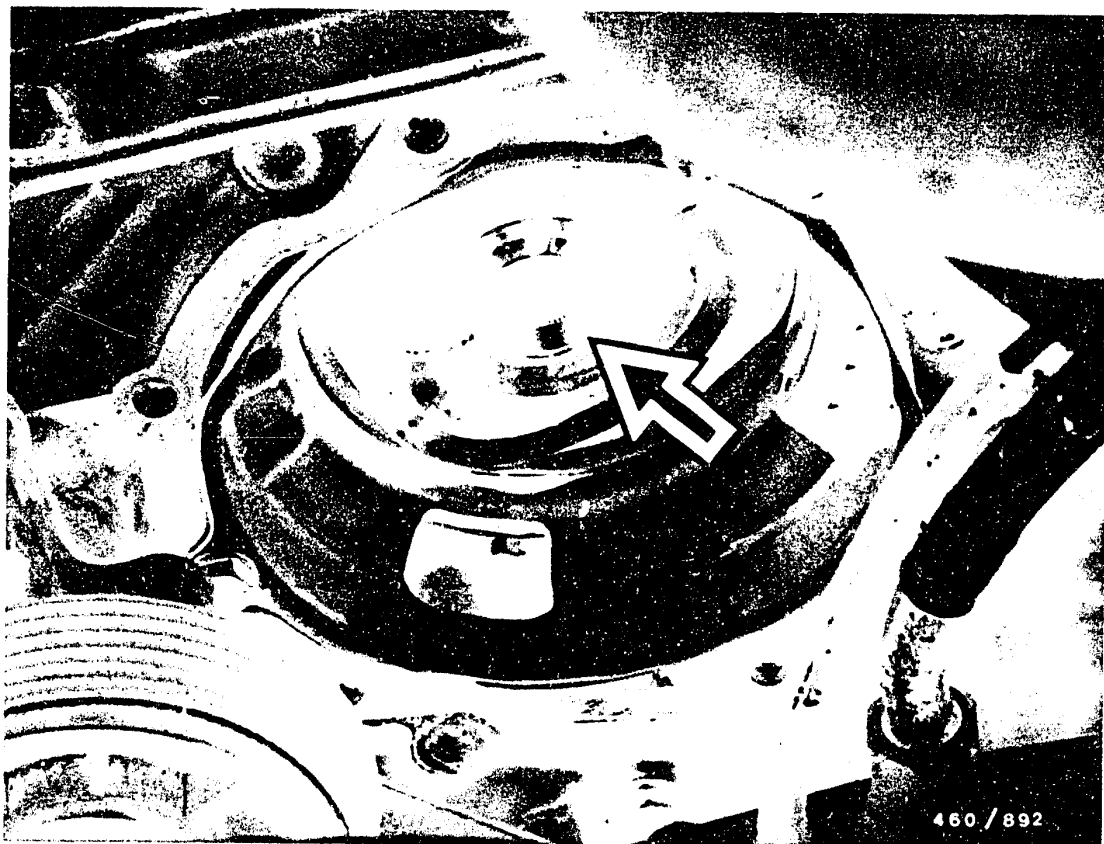
Before installing the injection pump, check whether the O-ring is fitted onto injection-pump flange (see picture, arrow).

G6

Install fuel-injection pump

Mercedes Benz 190 D





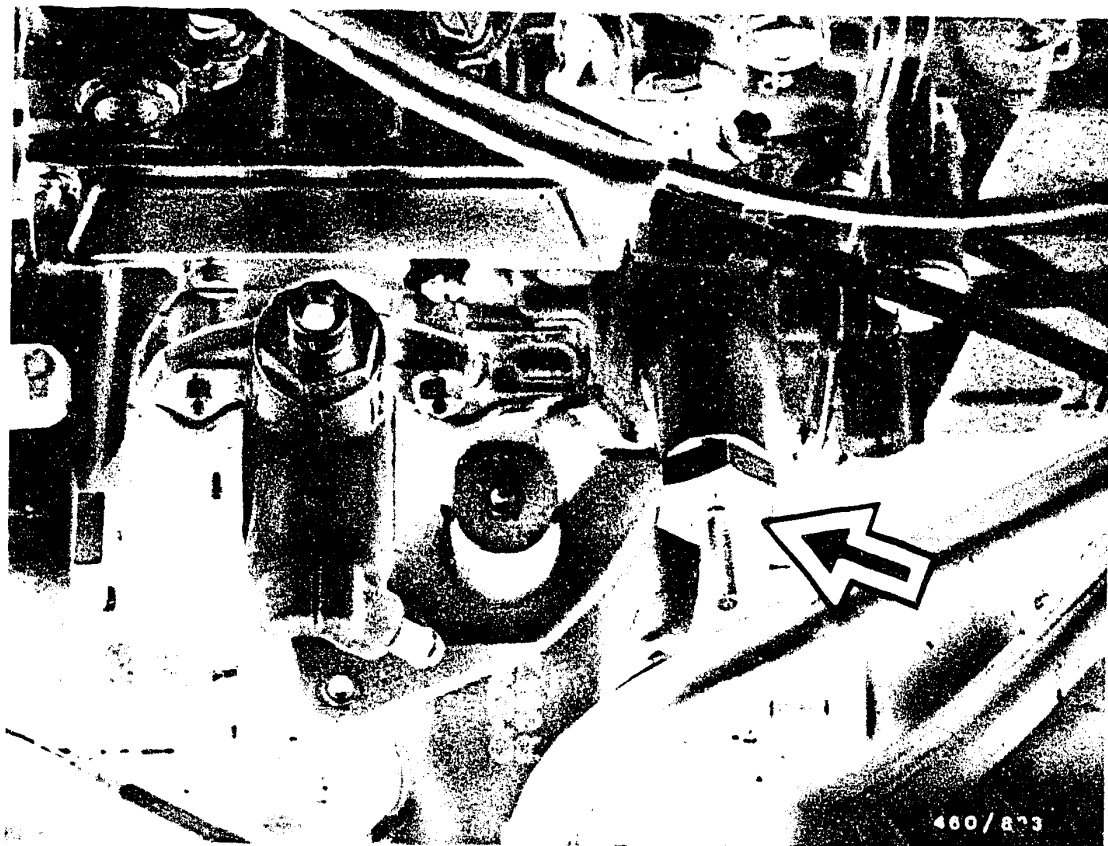
When installing the injection pump, make sure that the timing device (see picture, arrow) is not changed in its position.

G7

Install fuel-injection pump

Mercedes Benz 190 D





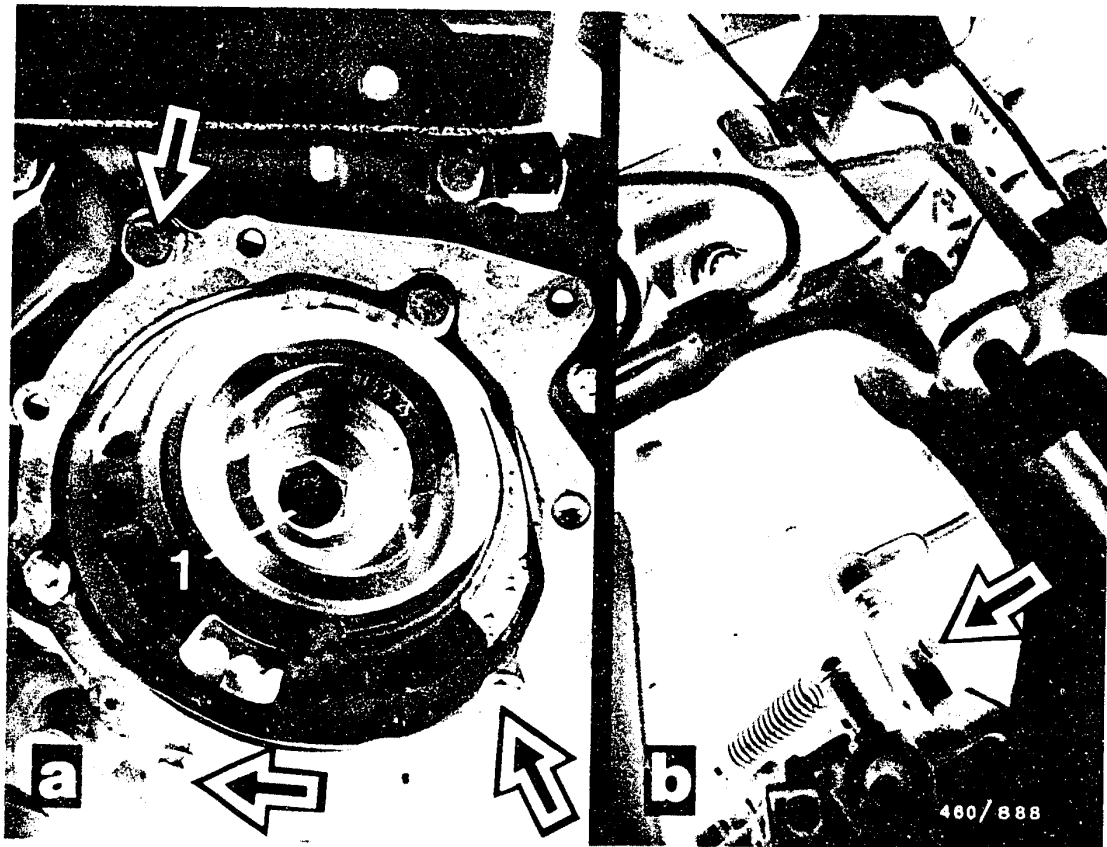
Introduce injection pump with holding device KDEP 1077 (see picture, arrow) into engine block so that injection-pump fastening screws are in the centre of the slots (this makes turning possible in order to make a fine adjustment to either side).

G8

Install fuel-injection pump

Mercedes Benz 190 D





1 = Central fastening screw on timing device (left-hand thread)

Finger-tighten fastening screws at drive end (picture a) and on support bracket (arrow, picture b).

Remove holding device KDEP 1077.

Mount screw plug with seal (Daimler Benz service part).

Insert central fastening screw (picture a) and tighten to 40 - 50 Nm. Caution: LEFT-HAND THREAD.

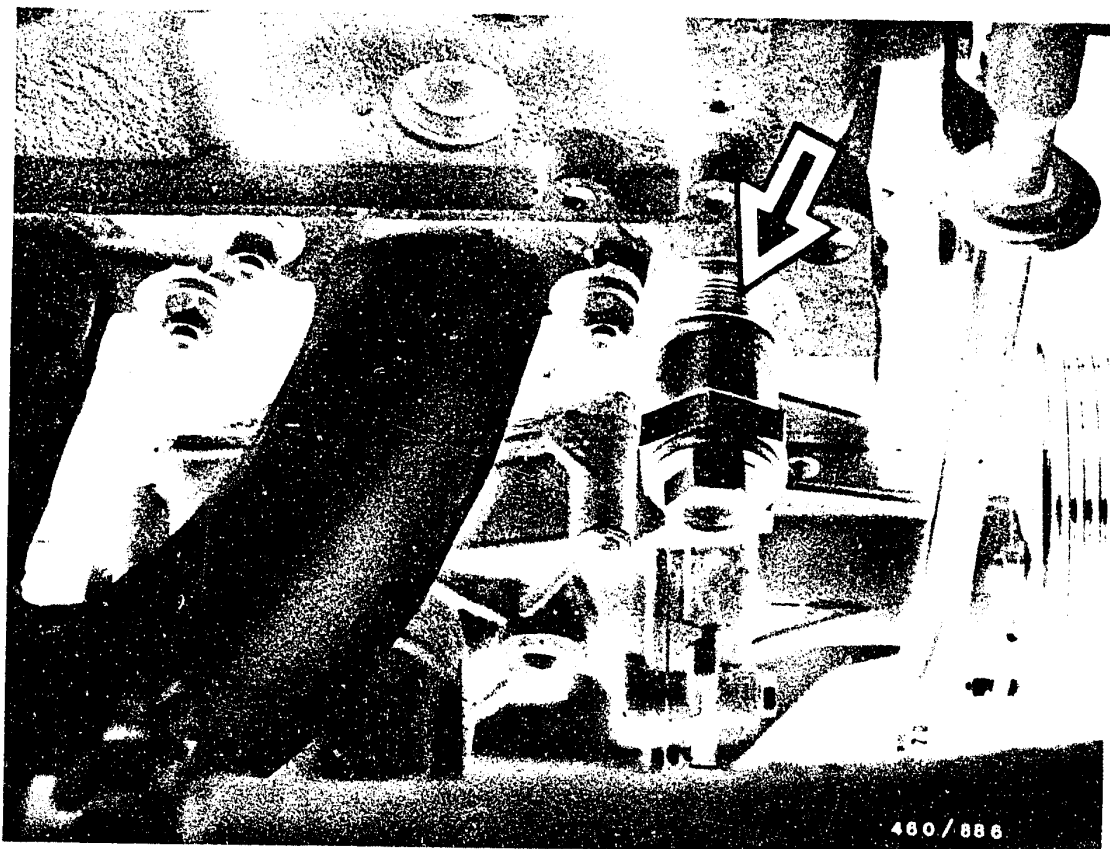
Hold crankshaft so that it cannot turn.

G9

Install fuel-injection pump

Mercedes Benz 190 D





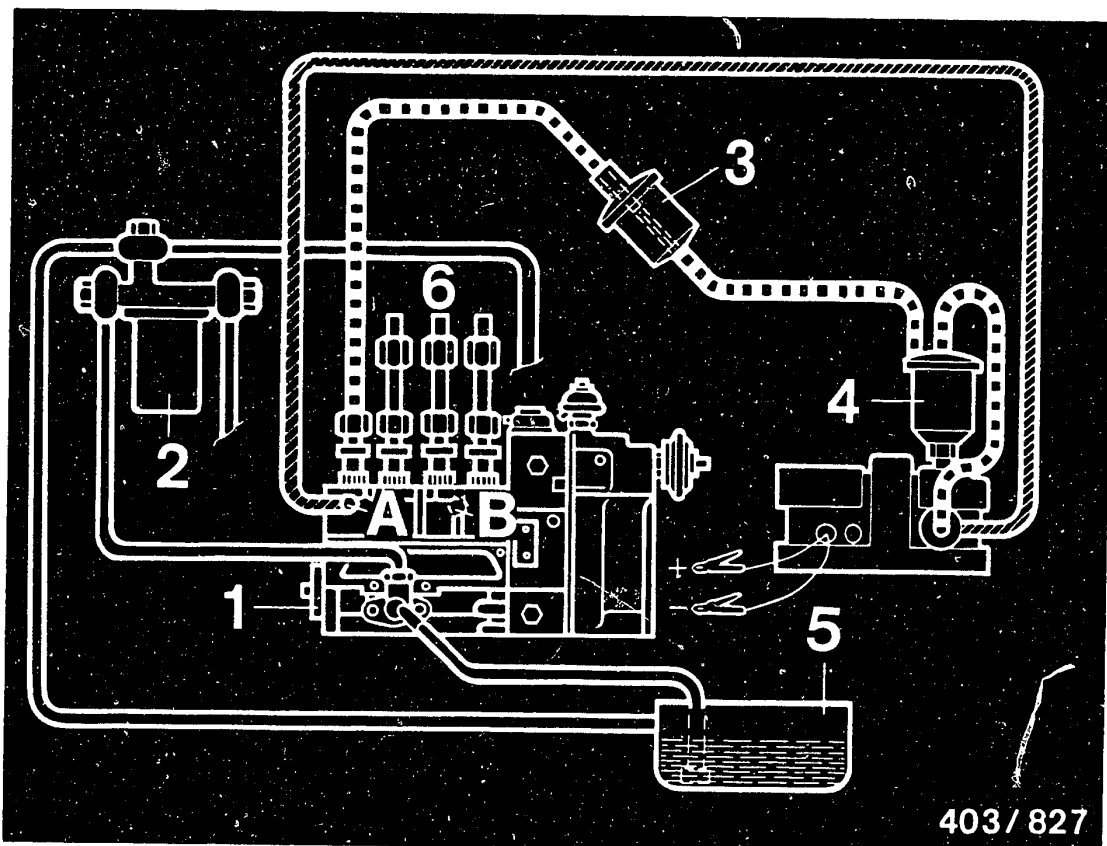
Screw in chain tensioner (see picture, arrow) and tighten to a torque of 80 Nm.

G 10


Install fuel-injection pump

Mercedes Benz 190 D





 Return line

 High pressure approx. 30 + 4 bar

- 1 = Injection pump
- 2 = Fuel filter
- 3 = Sight glass
- 4 = Start-of-delivery setting device
- 5 = Fuel tank
- 6 = Pressure-limiting valves

- A = Inlet-union screw, fuel inlet from start-of-delivery setting device
- B = Seal fuel return line with screw plug.

Connection diagram for setting the start of delivery (static)

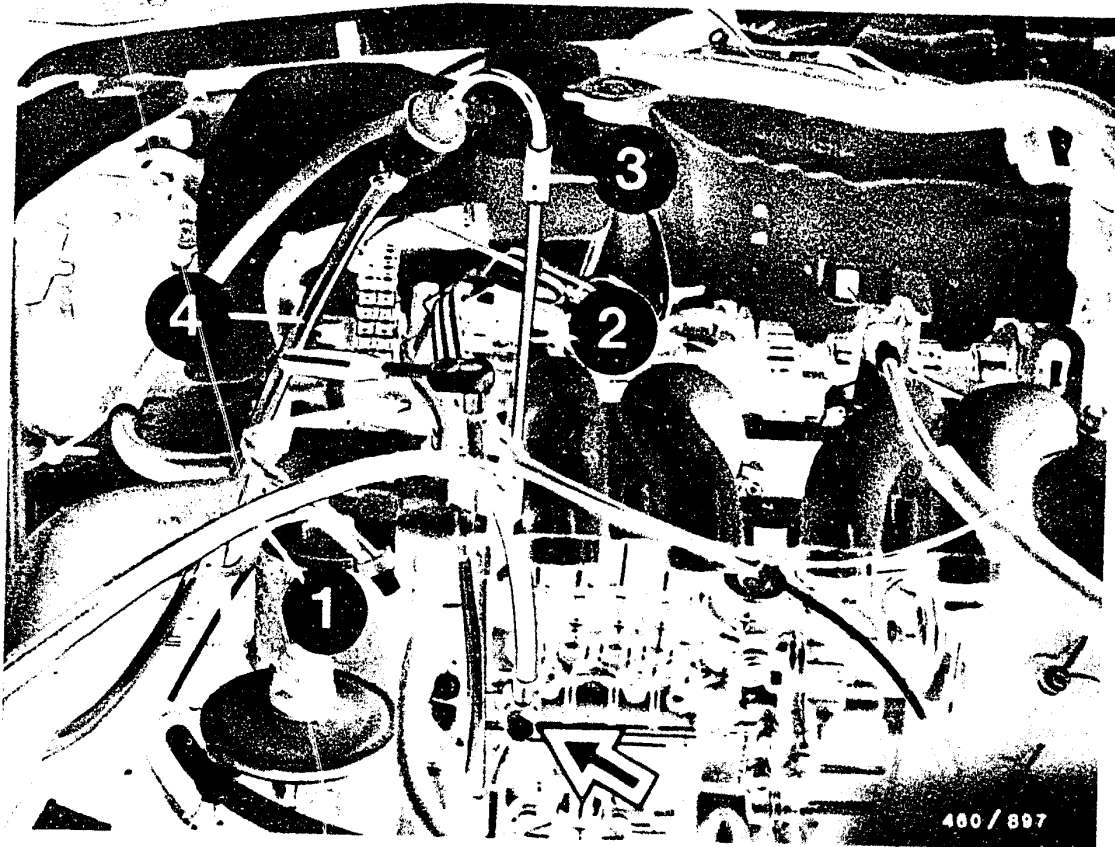
High-pressure overflow method

G11

Install fuel-injection pump

Mercedes Benz 190 D





- 1 = High-pressure hose
- 2 = Test line
- 3 = Pipe bend
- 4 = Return hose

Setting the start of delivery

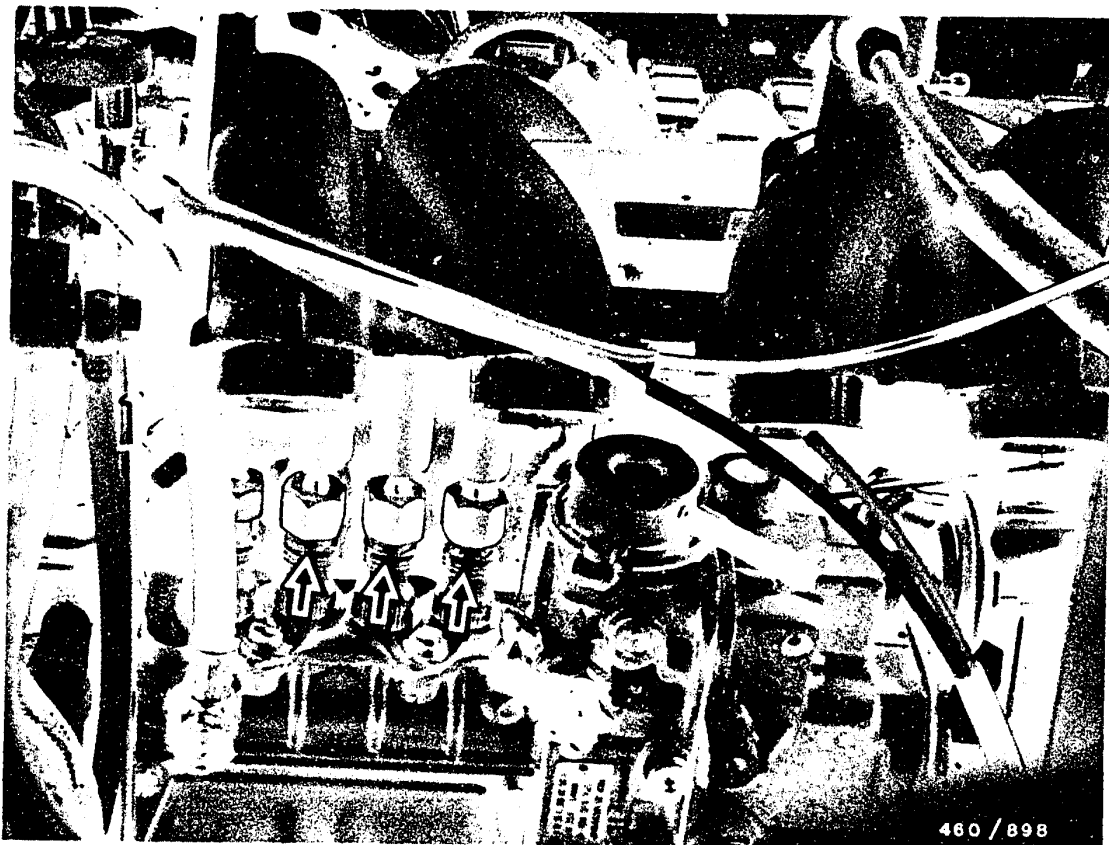
Place start-of-delivery setting device next to vehicle (e.g. on workshop trolley).

Connect high-pressure hose of device to suction chamber inlet of injection pump (see picture, arrow).

Seal return connection of pump by means of screw plug.

Secure test line KDEP-P 200/11 to delivery-valve holder of cyl. 1 (for start-of-delivery setting) and connect pipe bend. Hang return hose into fuel tank of start-of-delivery setting device.



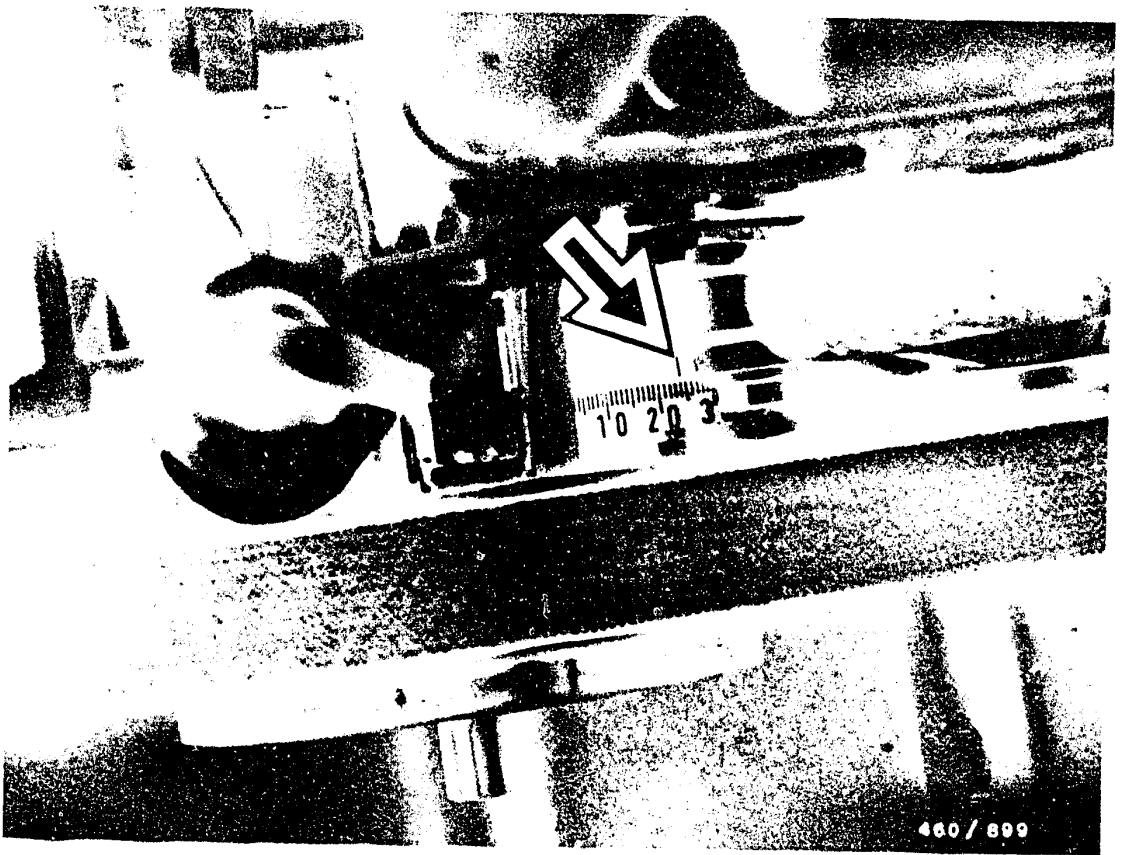


Seal the remaining pump outlets with pressure-limiting valves KDEP-P 200/13 (see picture, arrows). Connect electric leads of start-of-delivery setting device to vehicle battery (12 V) (red cable to +). Fill fuel tank of start-of-delivery setting device with diesel fuel.

G13

Install fuel-injection pump
Mercedes Benz 190 D





Turn crankshaft over twice in engine direction of rotation and set to approx. $+35^{\circ}$ BTDC on compression stroke of cylinder 1 (valve overlap on cylinder 4). Press injection-pump control rod to full load. Switch on start-of-delivery setting device.

Note:

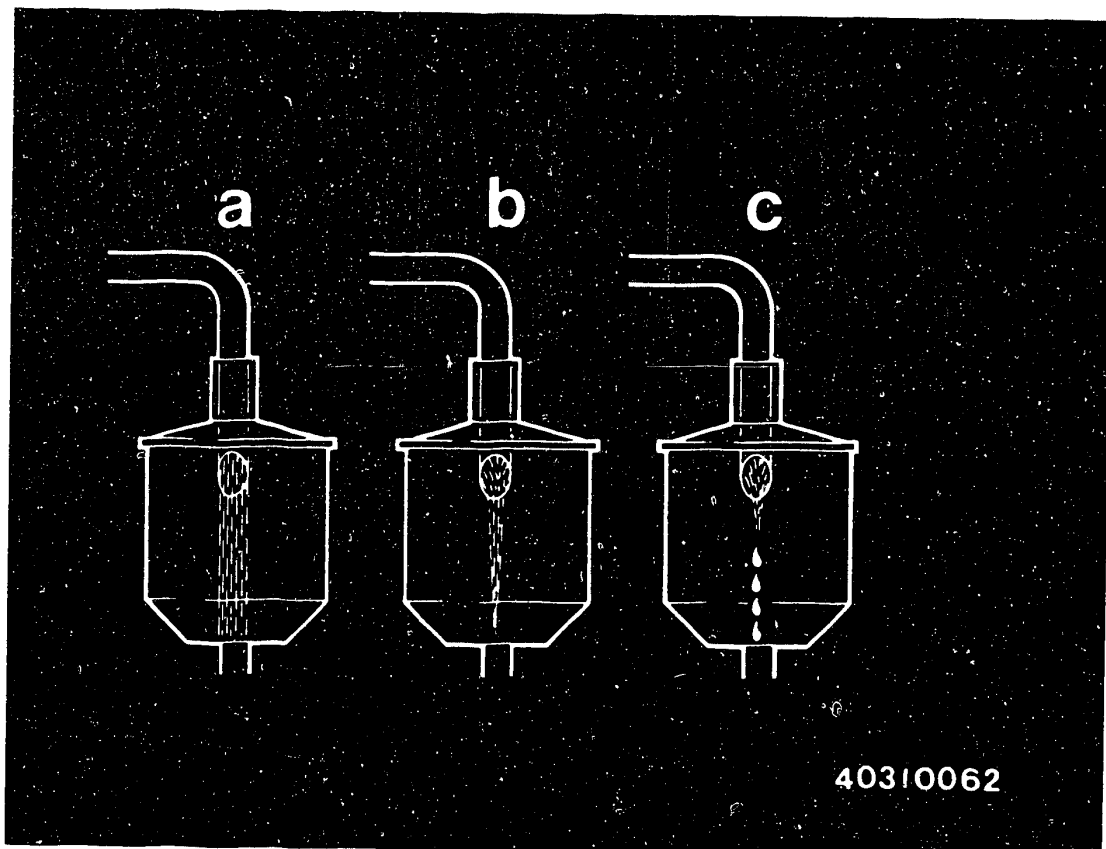
Switch on start-of-delivery setting device only for measuring. If injection nozzles are leaking, it is otherwise possible for fuel to enter the combustion chamber.

G14

Install fuel-injection pump

Mercedes Benz 190 D





40310062

- a = Full fuel jet
- b = Tapered fuel jet just before start of delivery
- c = Chain of drips - start of delivery

Slowly continue to turn crankshaft in direction of rotation of engine.

While doing this, observe fuel jet in sight glass.

When the jet turns into a chain of drips, the start of delivery has been reached.

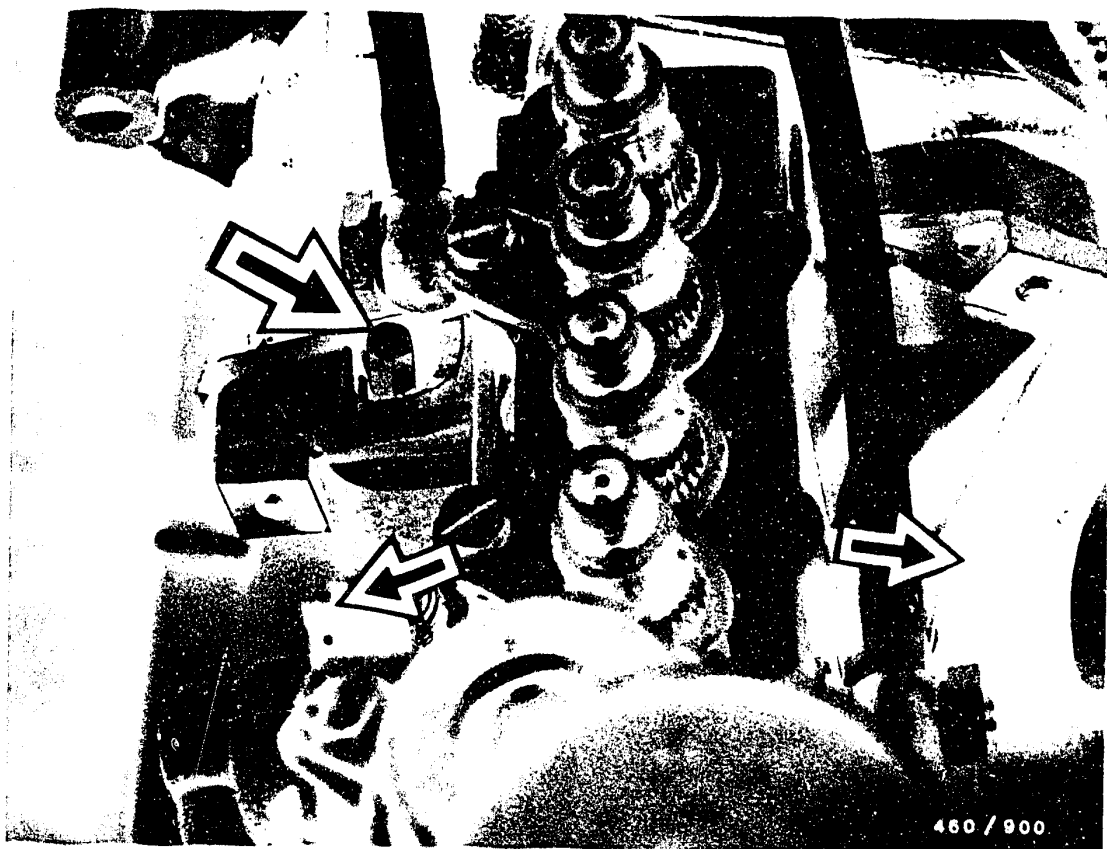
Set value 24° BTDC.

G15

Install fuel-injection pump

Mercedes Benz 190 D





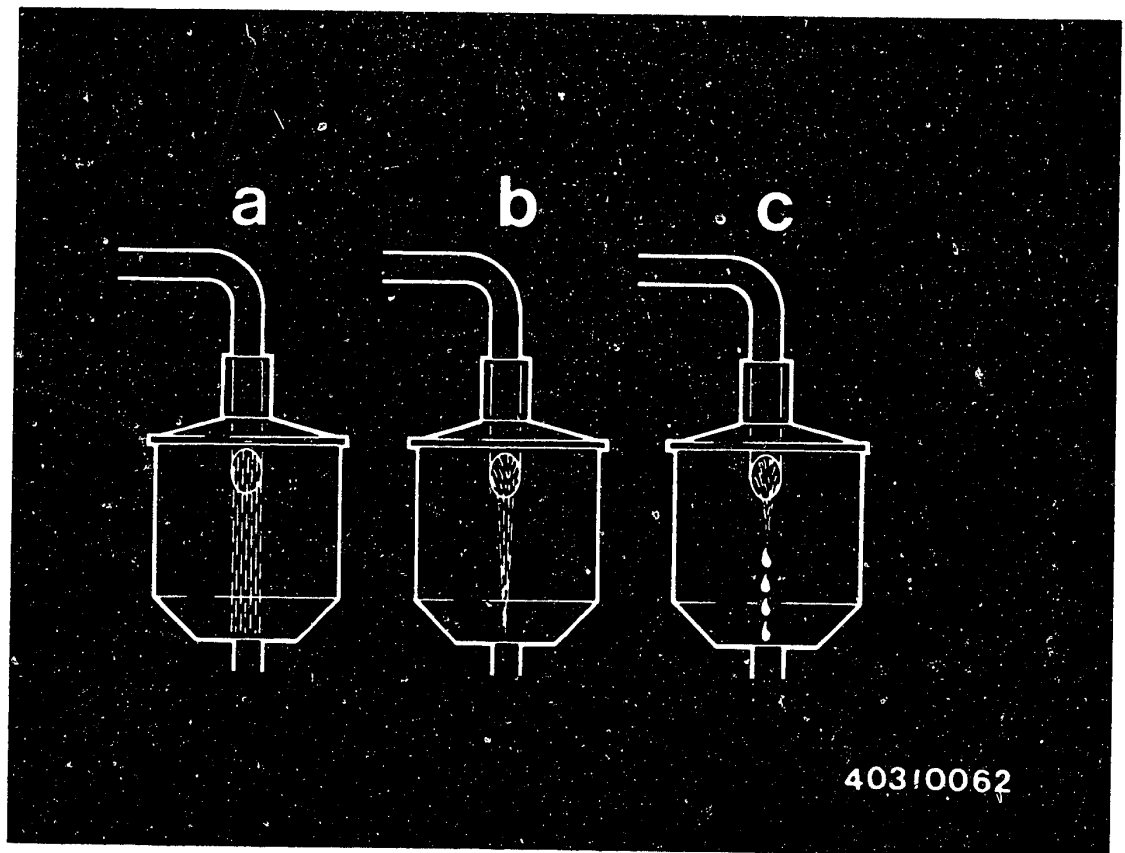
If set value is not reached, pivot injection pump by turning the adjusting screw (see picture, arrow).
Turning the adjusting screw to the right = start of delivery comes later
Turning the adjusting screw to the left = start of delivery comes earlier.
If the range of adjustment is not enough, the injection pump must be relocated.
Then test the start of delivery again.

G16

Install fuel-injection pump

Mercedes Benz 190 D





- a = Full fuel jet
 b = Tapered fuel jet just before start of delivery
 c = Chain of drips - start of delivery

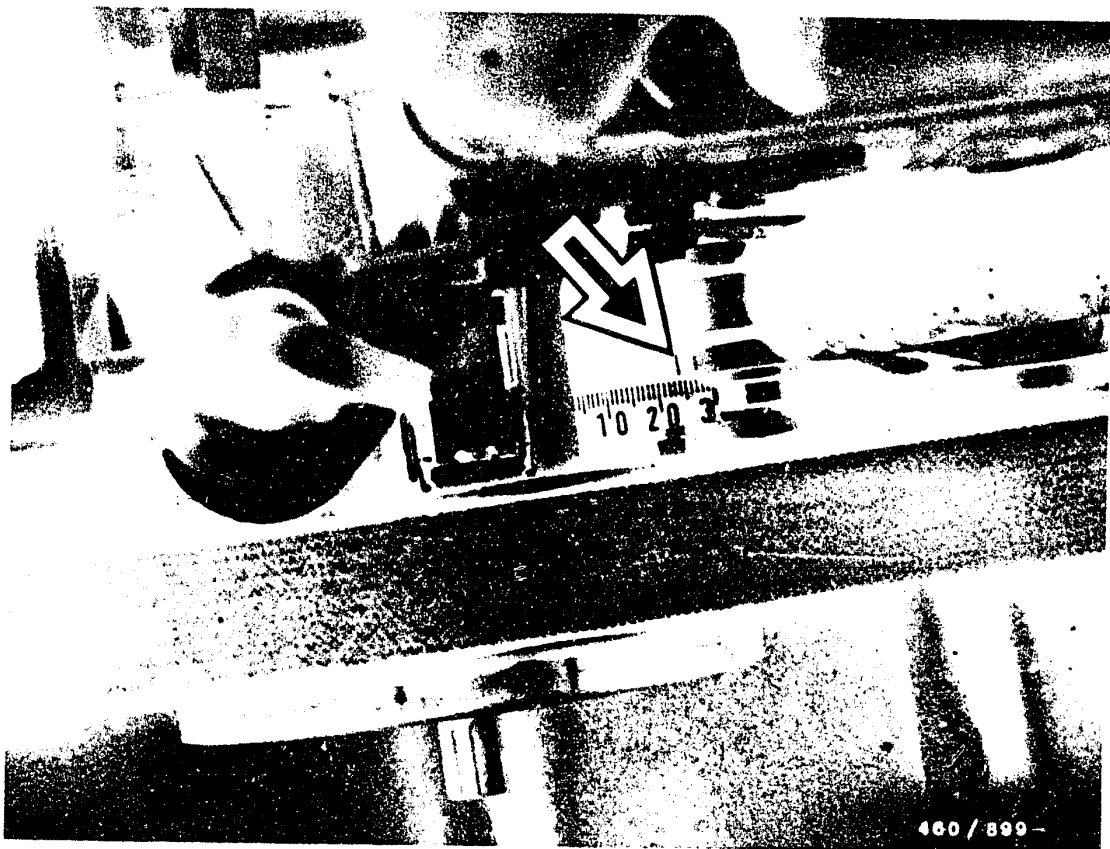
Turn engine over in direction of rotation to just before start of delivery (approx. 35° BTDC).
 Switch on start-of-delivery setting device. Press injection-pump control rod to full load.
 Turn engine further in direction of rotation. While doing this, observe fuel jet in sight glass. The start of delivery has been reached when the fuel jet changes into a chain of drips.

G17

Install fuel-injection pump

Mercedes Benz 190 D





In this position the engine marks for start of delivery must align (see picture).

Set value: 24° BTDC

Switch off start-of-delivery setting device and remove accessories.

Remove screw plug from injection-pump return.

Tighten injection-pump fastening screw (20 - 25 Nm).

G 18

Install fuel-injection pump

Mercedes Benz 190 D



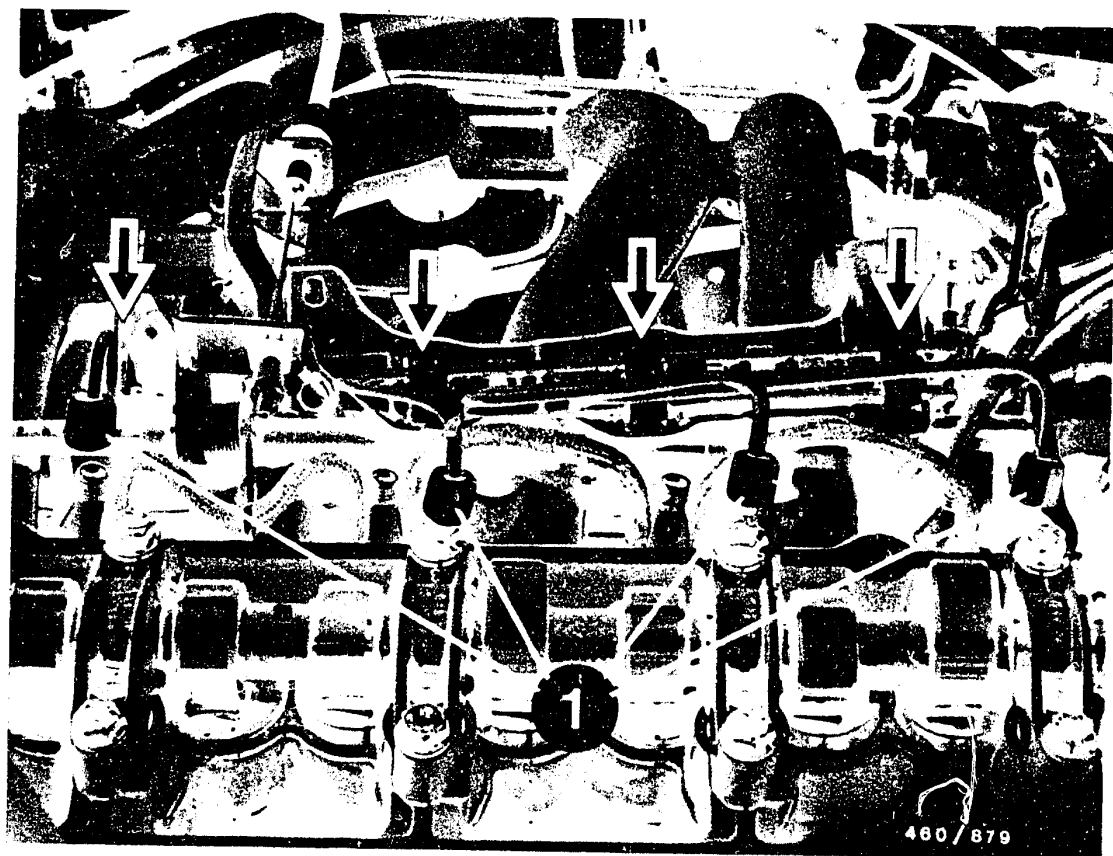


- 1 = Fuel supply pump
- 2 = Fuel thermostat
- 3 = Suction line
- 4 = Fuel prefilter

Mount fuel thermostat.

Mount suction line on fuel supply pump.





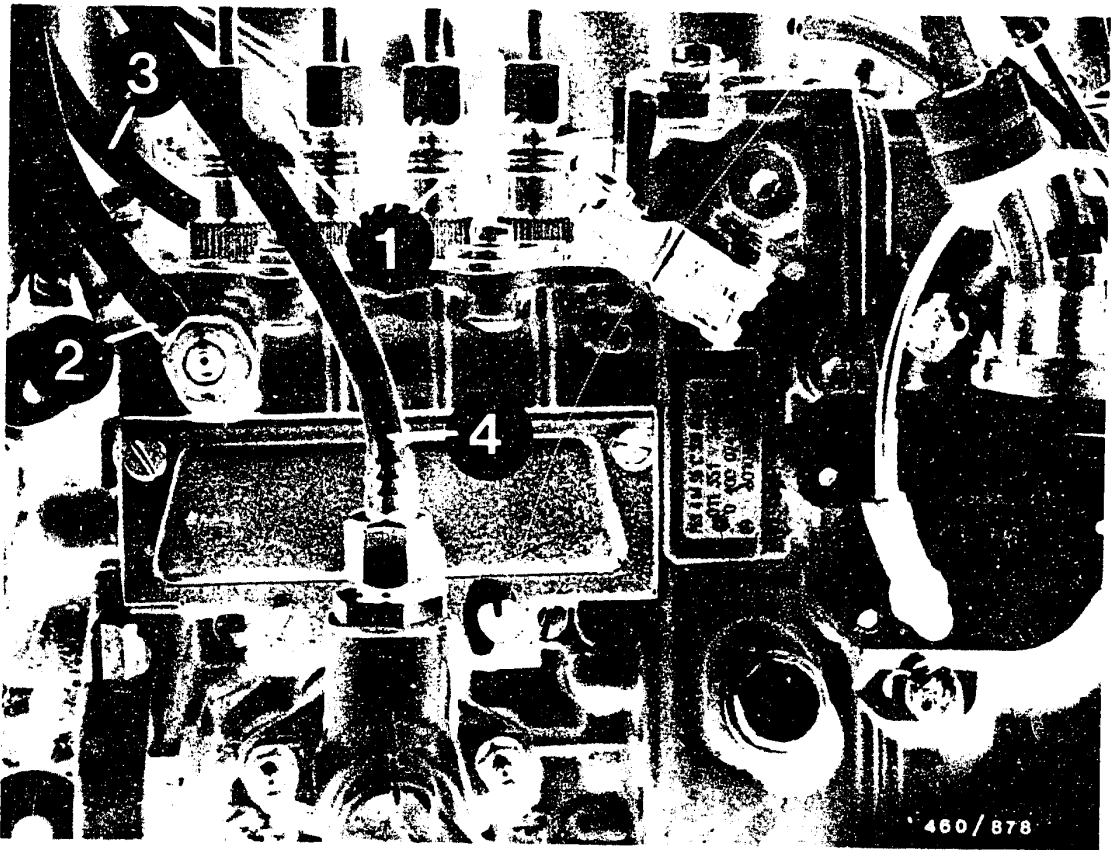
1 = Injection lines

Mount injection lines on nozzle-holder assemblies.
Mount fastening screws and fuel clip (see picture, arrows).

G20

Install fuel-injection pump
Mercedes Benz 190 D

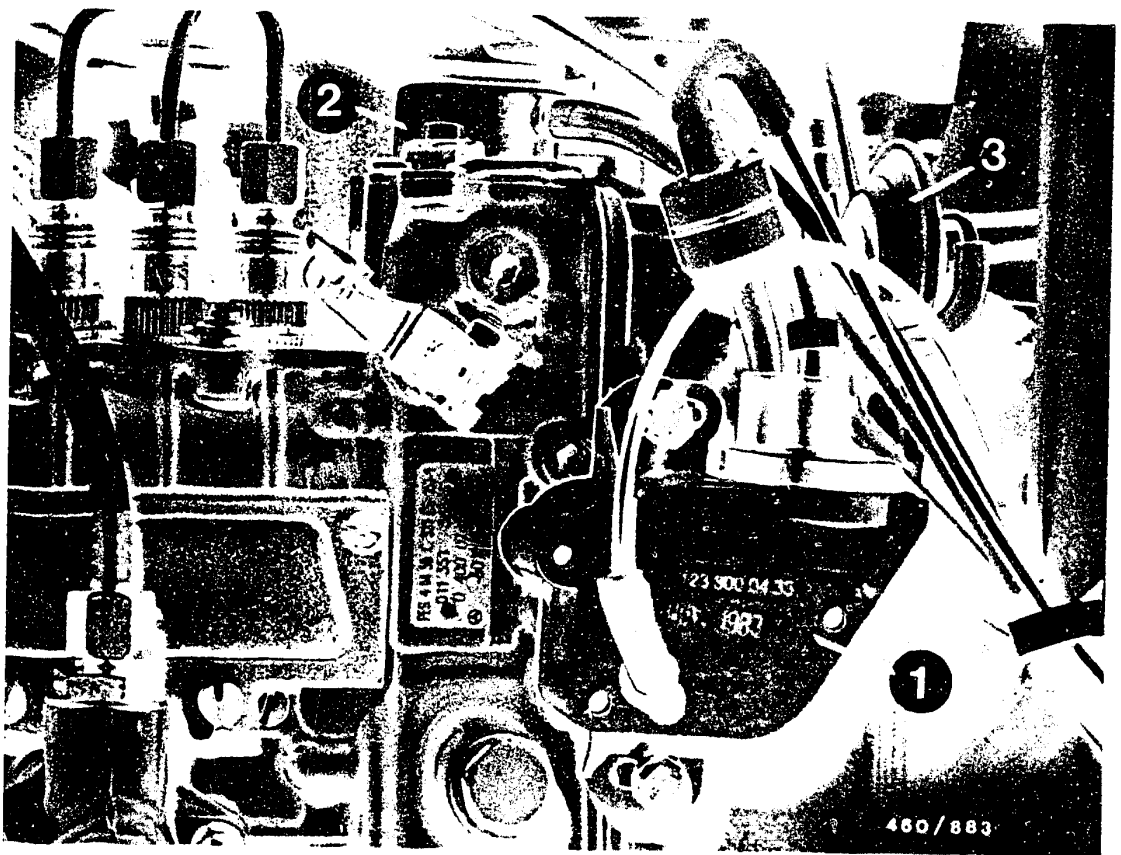




- 1 = Injection lines
- 2 = Fuel inlet line
- 3 = Fuel return line
- 4 = Inlet line to fuel filter

Connect injection lines to injection pump.
Mount fuel inlet line, fuel return line and inlet line
to fuel filter.

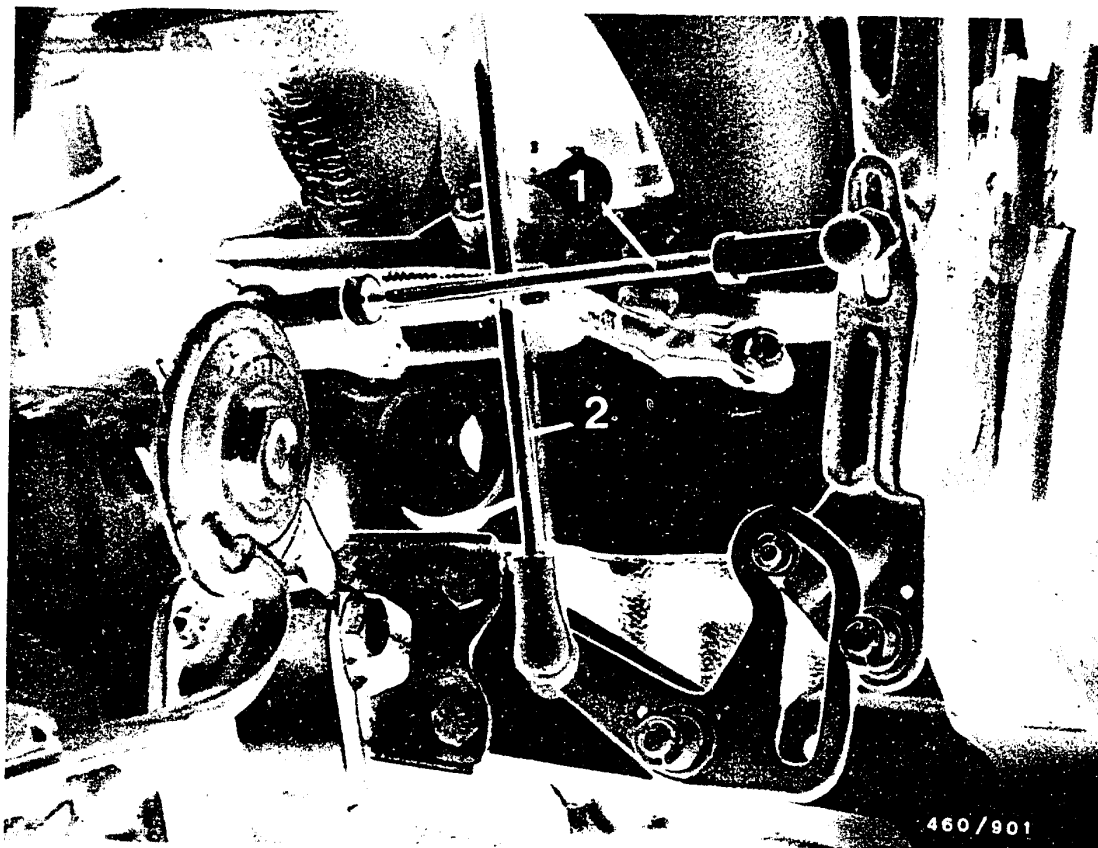




- 1 = Vacuum unit
- 2 = Shutoff box
- 3 = Vacuum control valve

Mount vacuum lines on vacuum unit for idle increase, on shutoff box and, on vehicles with automatic transmission, on vacuum control valve.





- 1 = Connecting rod to injection pump
2 = Connecting rod to regulating lever

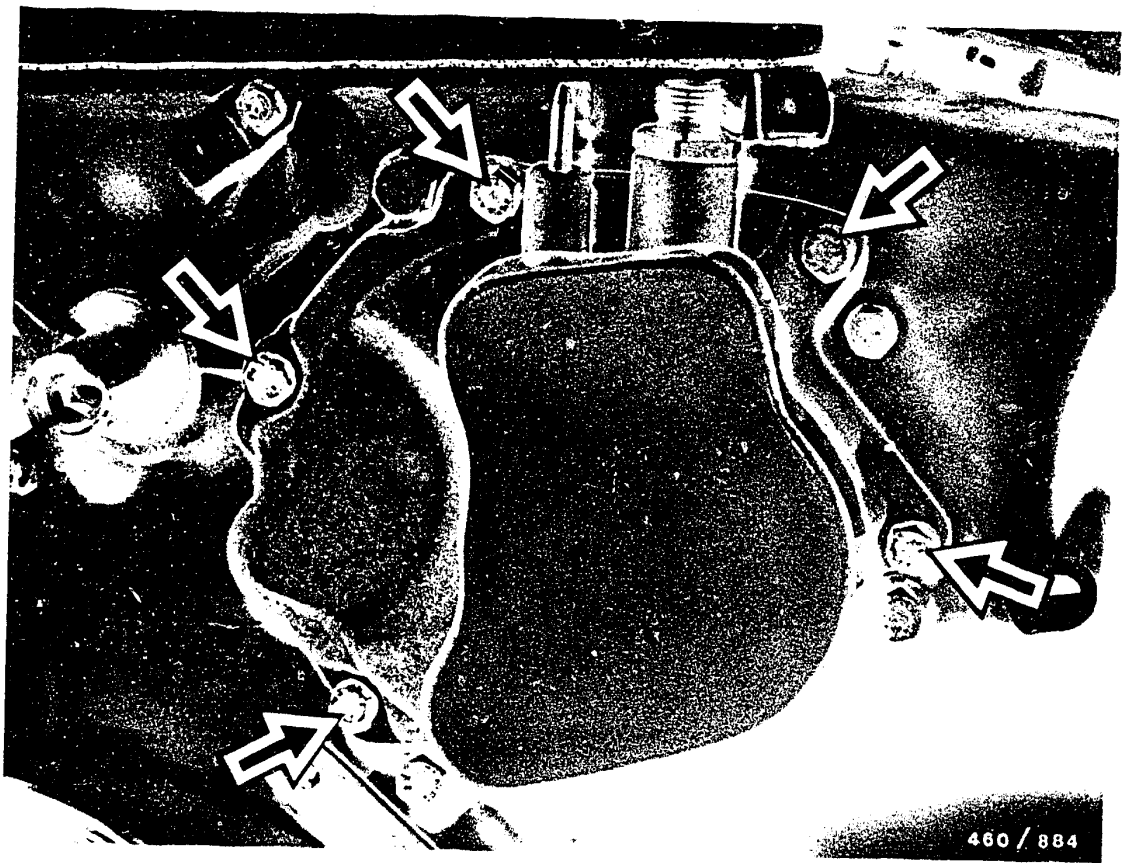
Hook connecting rod into injection-pump control lever.
Hook connecting rod into regulating lever.

G23

Install fuel-injection pump

Mercedes Benz 190 D



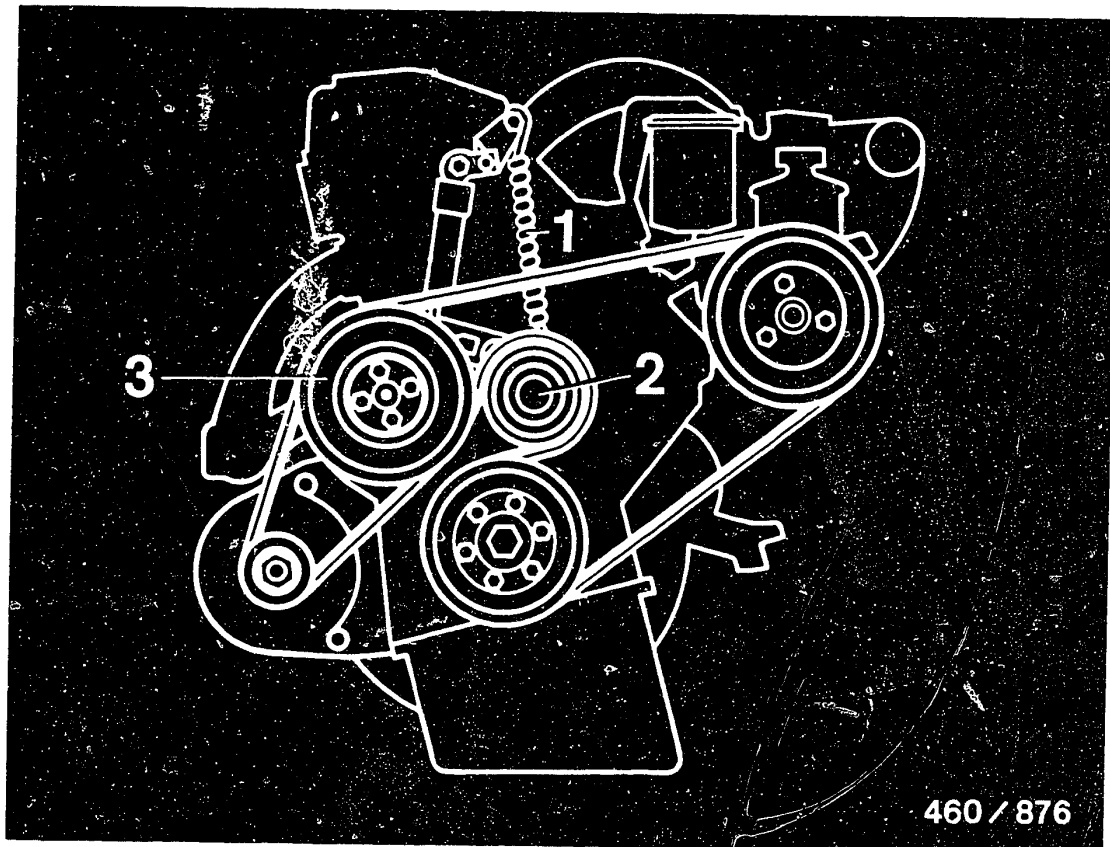


Mount vacuum pump.
Tighten fastening screws (see picture, arrows).

G24

Install fuel-injection pump
Mercedes Benz 190 D





460 / 876

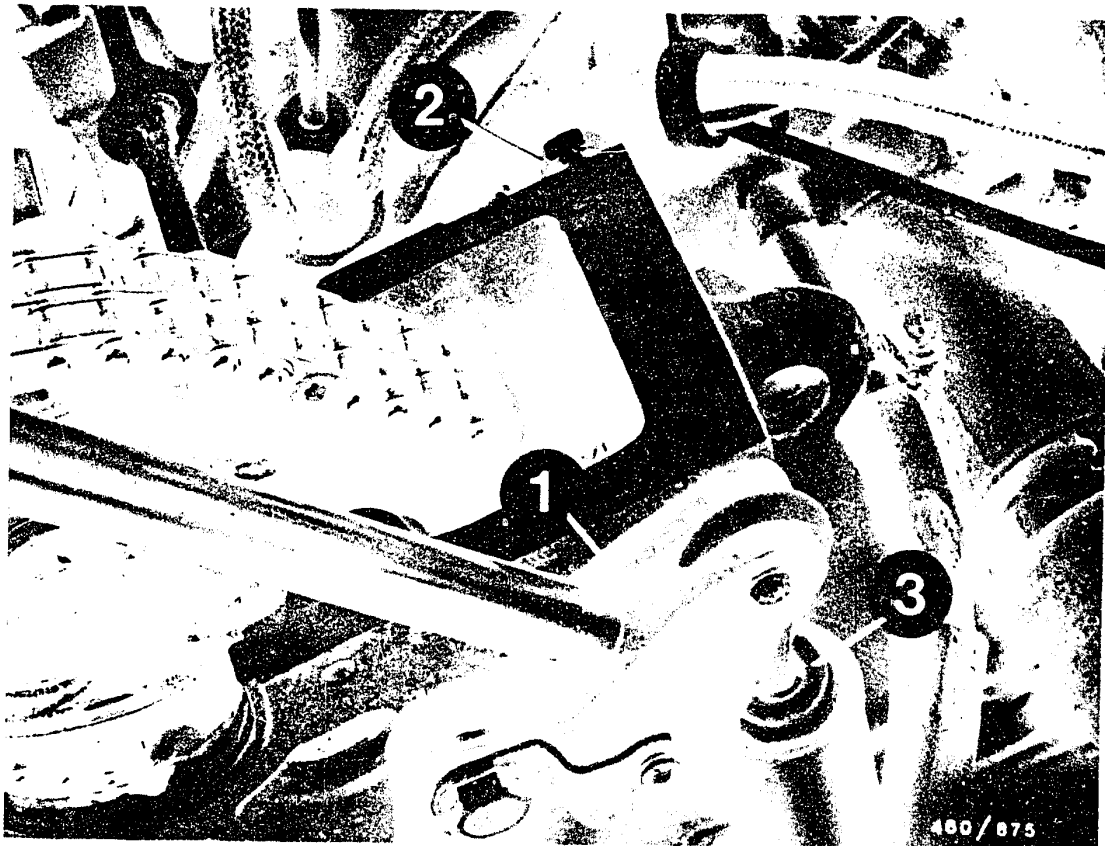
- 1 = Extension spring
- 2 = Tensioning roller
- 3 = Coolant pump

Place on ribbed V-belt.
Start at tensioning roller and finish at coolant pump.
Hook extension spring into tensioning roller.
Mount cylinder head cover.

H1

Install fuel-injection pump
Mercedes Benz 190 D





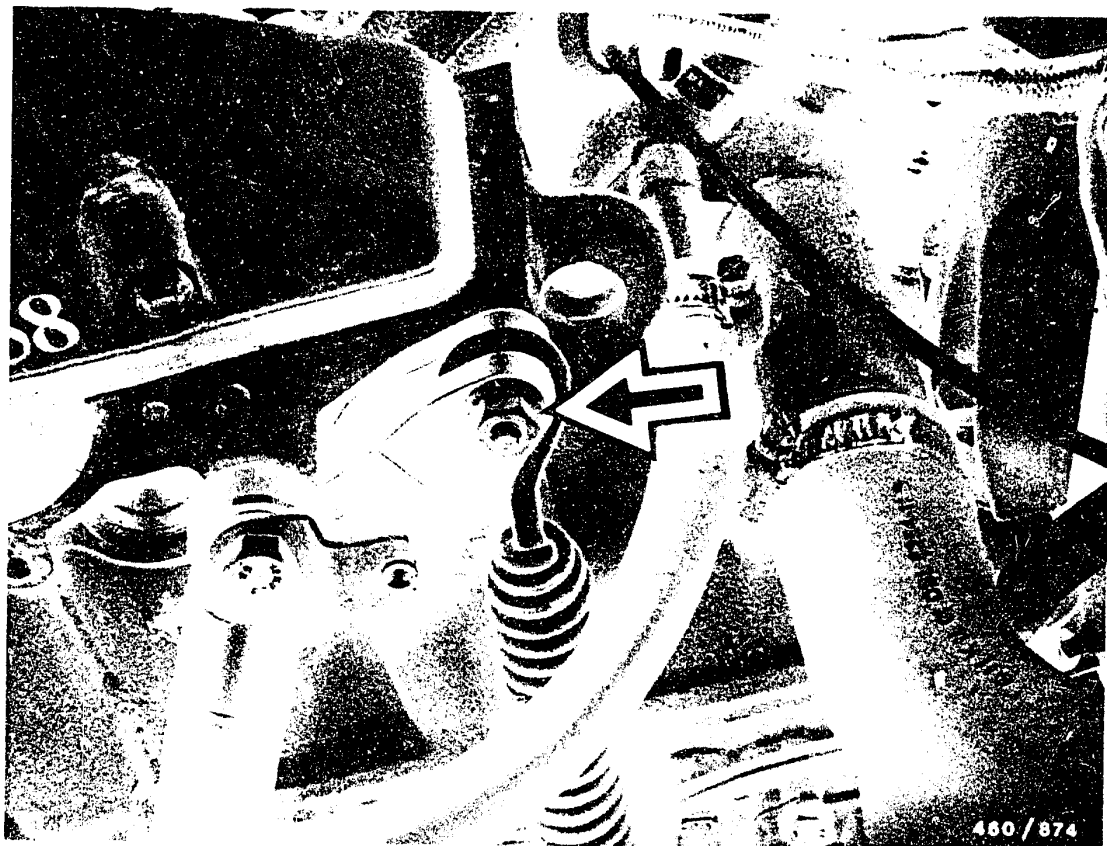
- 1 = Spring tensioning lever
- 2 = Fastening screw
- 3 = Extension spring

Tension extension spring. To do this, fit lever or mandrel (12 - 13 mm \emptyset , approx. 300 mm long) into bore on spring tensioning lever. Press lever to the left and slide fastening screw through spring tensioning lever.

H2

Install fuel-injection pump
Mercedes Benz 190 D



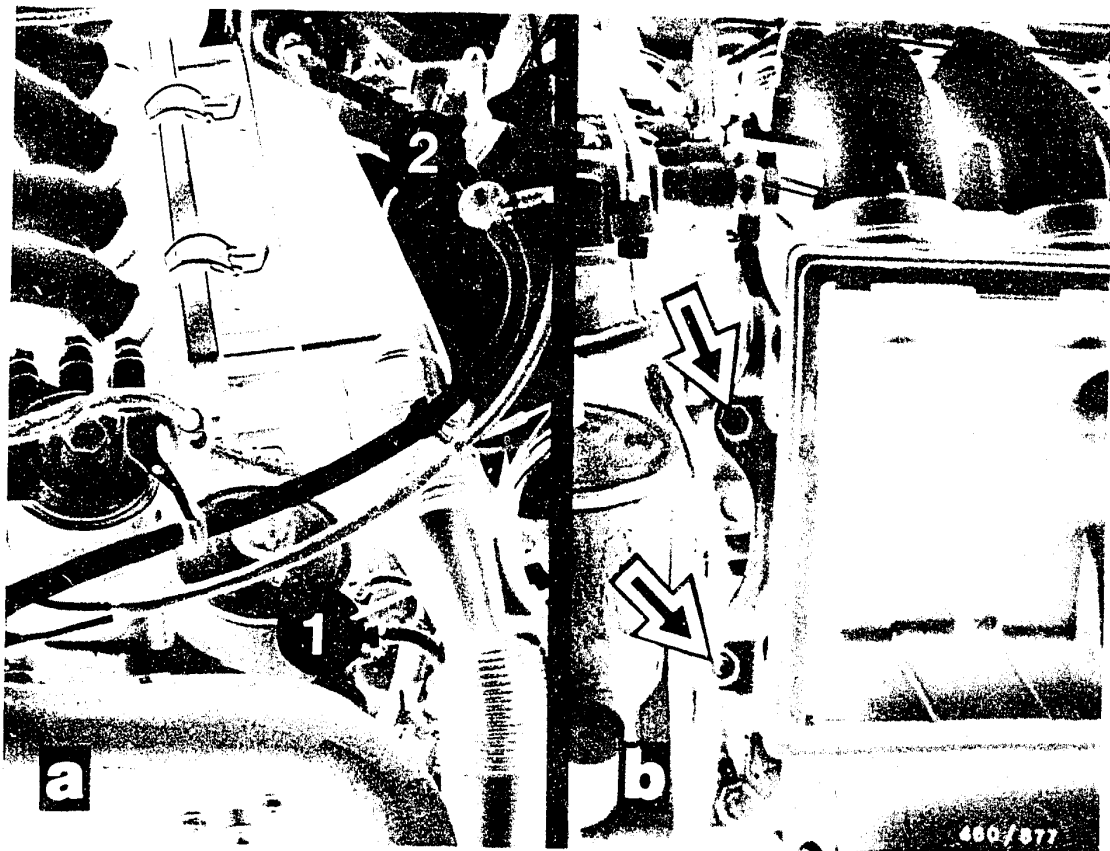


Tighten belt tensioner fastening nut (see picture, arrow).

H3

Install fuel-injection pump
Mercedes Benz 190 D





1 = Air-intake dome
2 = Air filter cover

Mount side holders for air guide housing (see picture b, arrows).

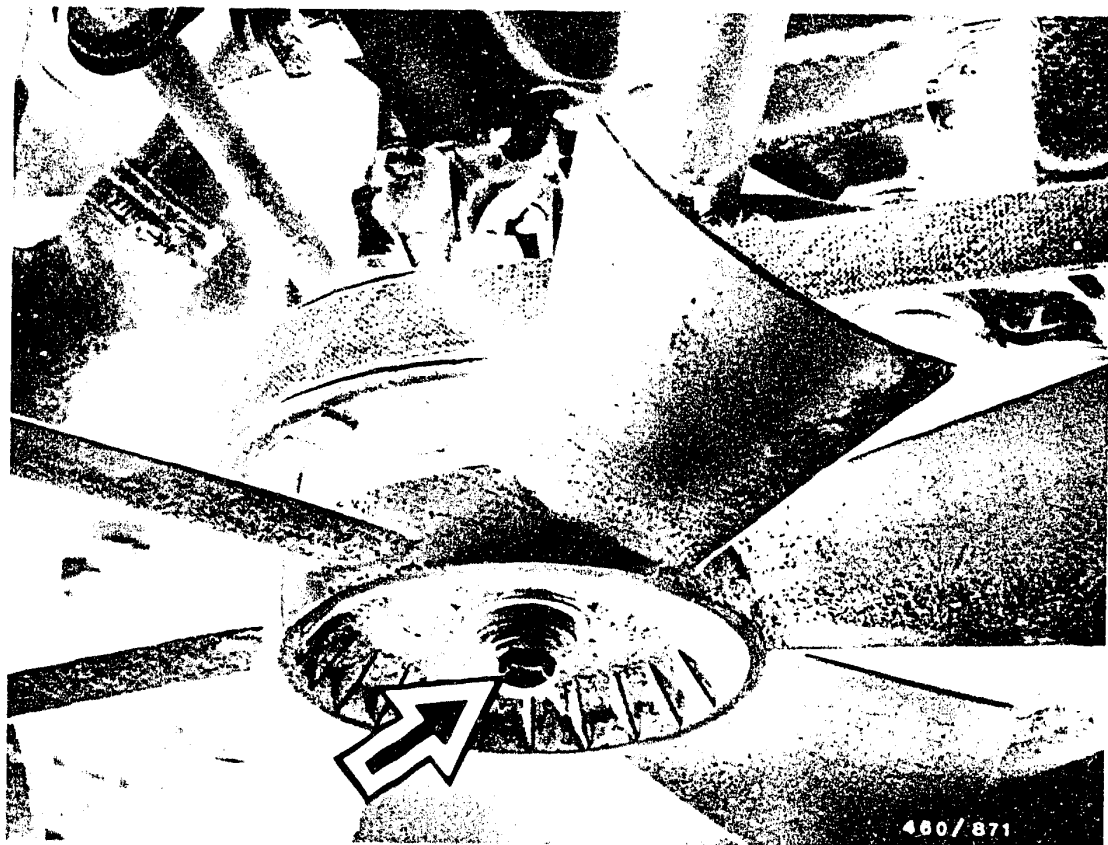
Mount air filter cover and slide on air-intake dome.

H4

Install fuel-injection pump

Mercedes Benz 190 D





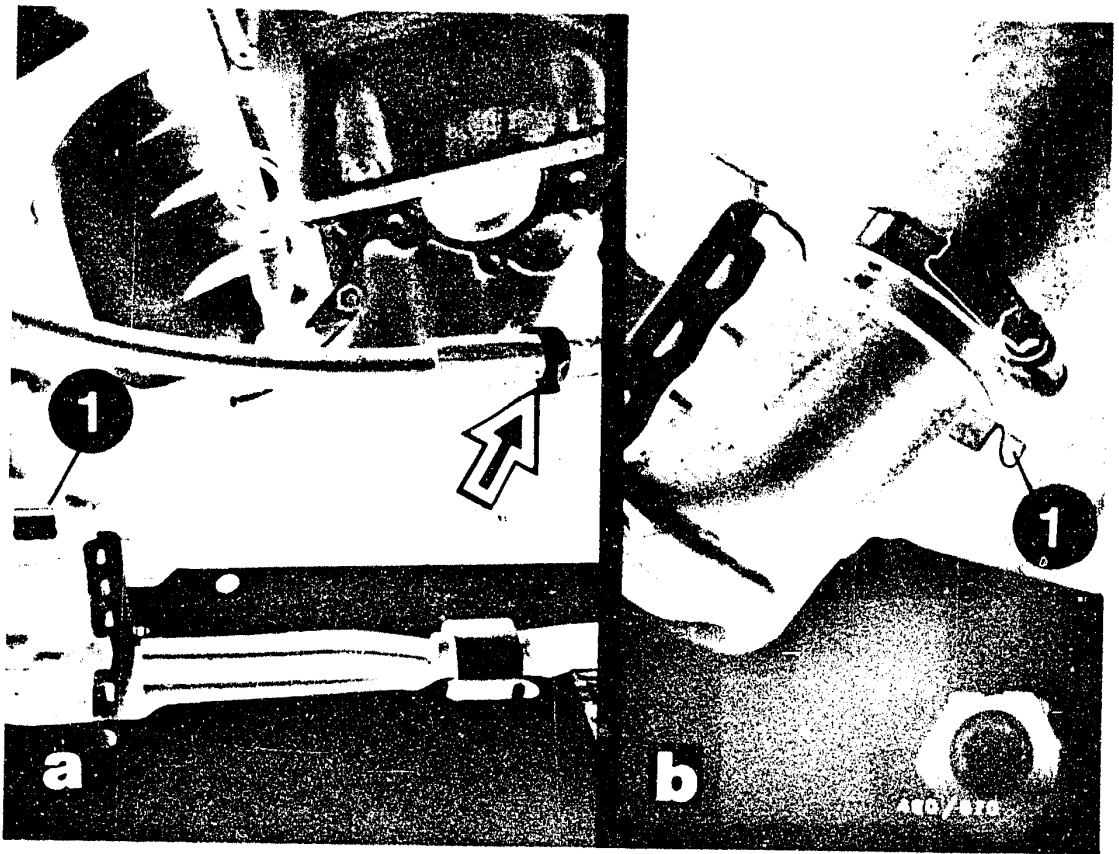
Mount fan and fan cover on radiator.
Tighten fan fastening screw (see picture, arrow).

H5

Install fuel-injection pump

Mercedes Benz 190 D





1 = Fan shrouds

Mount fan shrouds (pictures a and b) and hose binder (arrow, picture a).

Connect negative cable to battery.

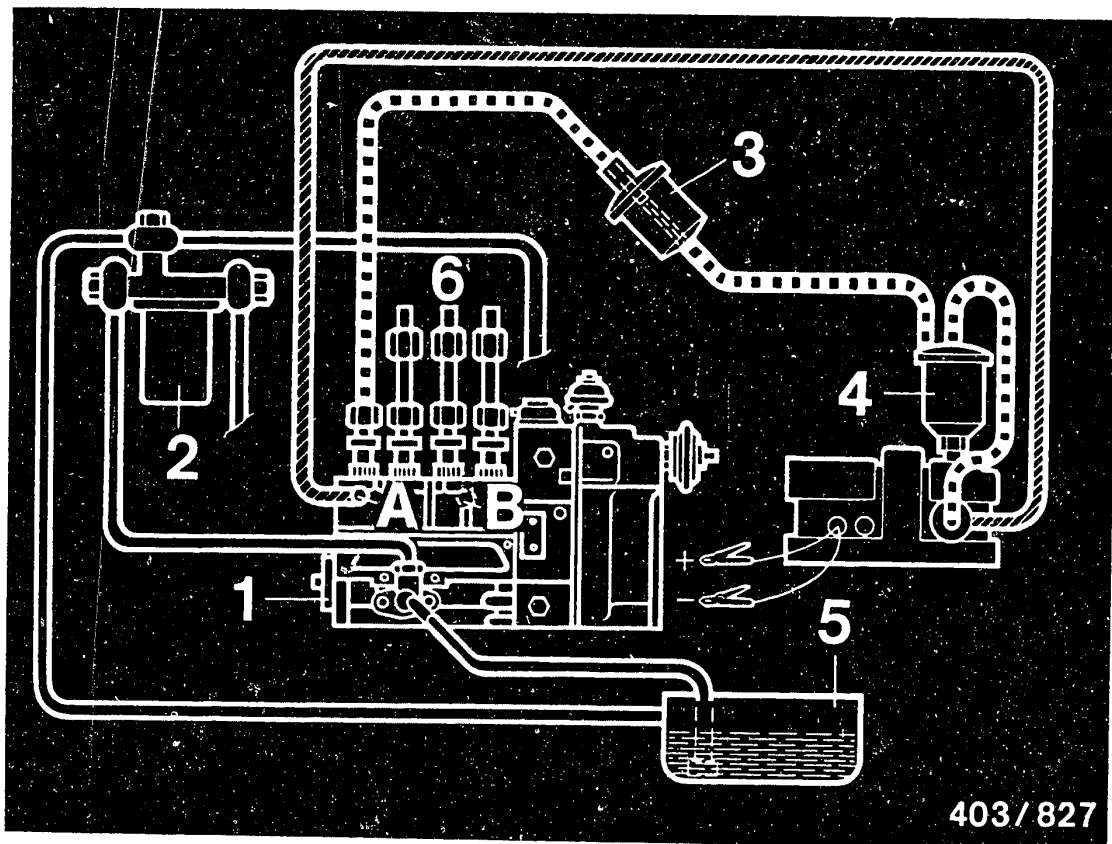
Mount front noise capsule.

H6


Install fuel-injection pump

Mercedes Benz 190 D





 Return line

 High pressure approx. 30 + 4 bar

1 = Injection pump

2 = Fuel filter

3 = Sight glass

4 = Start-of-delivery
setting device

5 = Fuel tank

6 = Pressure-limiting
valves

A = Inlet-union screw, fuel
inlet from start-of-
delivery setting device

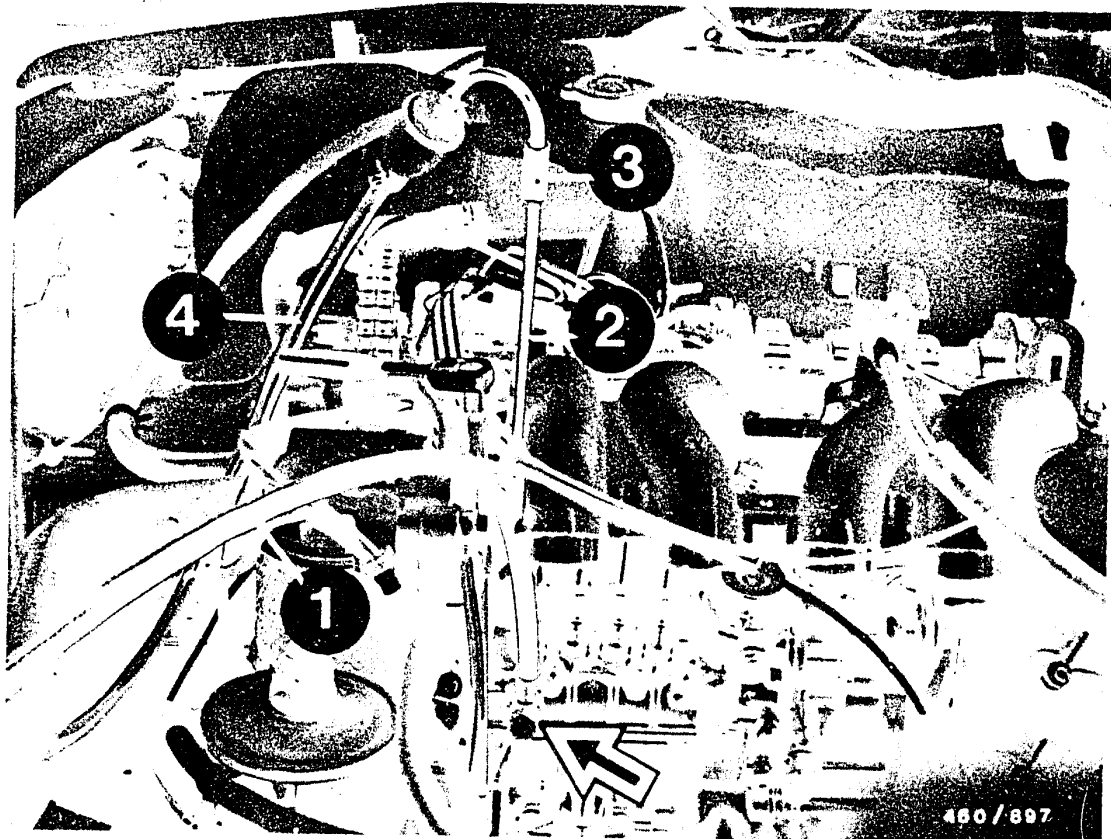
B = Seal fuel return line
with screw plug.

28. Injection timing

28.1 Static testing of start of delivery

Connection diagram for start of delivery - high-pressure
overflow method.





- 1 = High-pressure hose
- 2 = Test line
- 3 = Pipe bend
- 4 = Return hose

Remove complete air filter housing. Disconnect vacuum line from shutoff box.

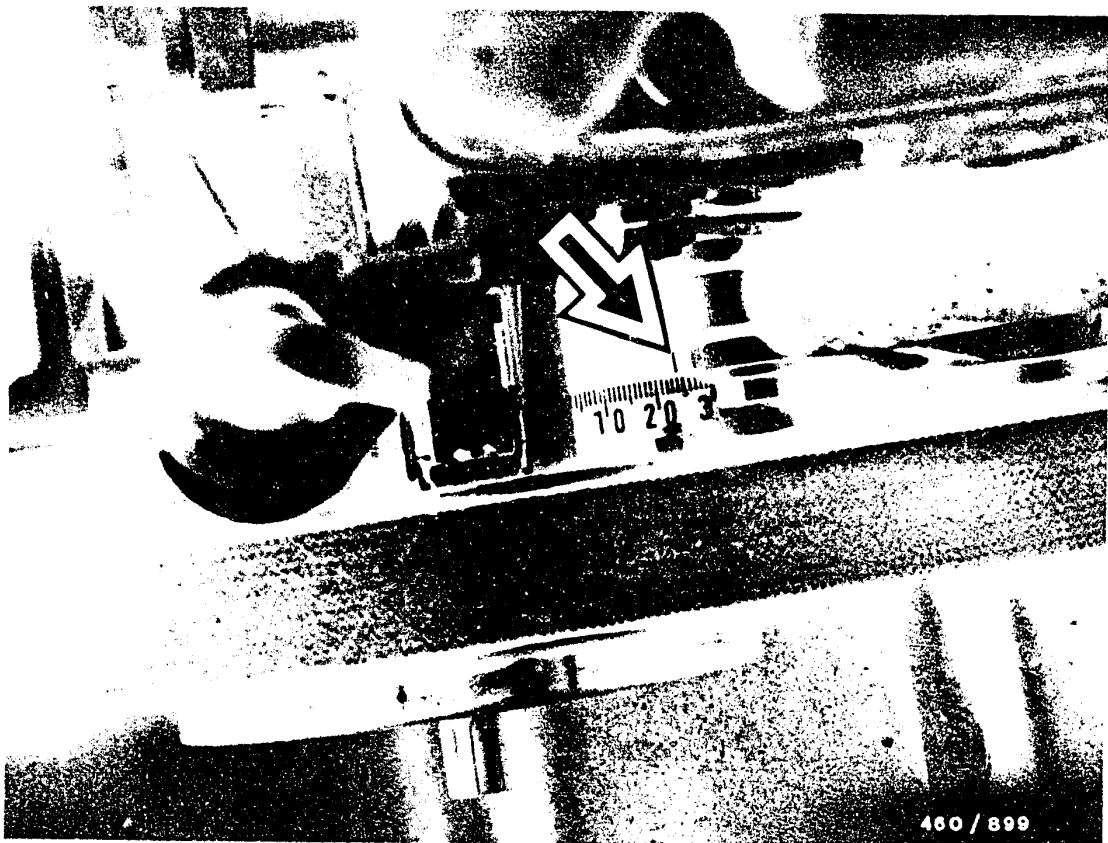
Place start-of-delivery setting device next to vehicle (e.g. on workshop trolley).

Connect high-pressure hose of device to suction chamber inlet of injection pump (see picture, arrow).

Seal return connection of pump by means of screw plug.

Secure test line KDEP-P 200/11 to delivery-valve holder of cyl. 1 (for start-of-delivery setting) and connect pipe bend. Hang return hose into fuel tank of start-of-delivery setting device.





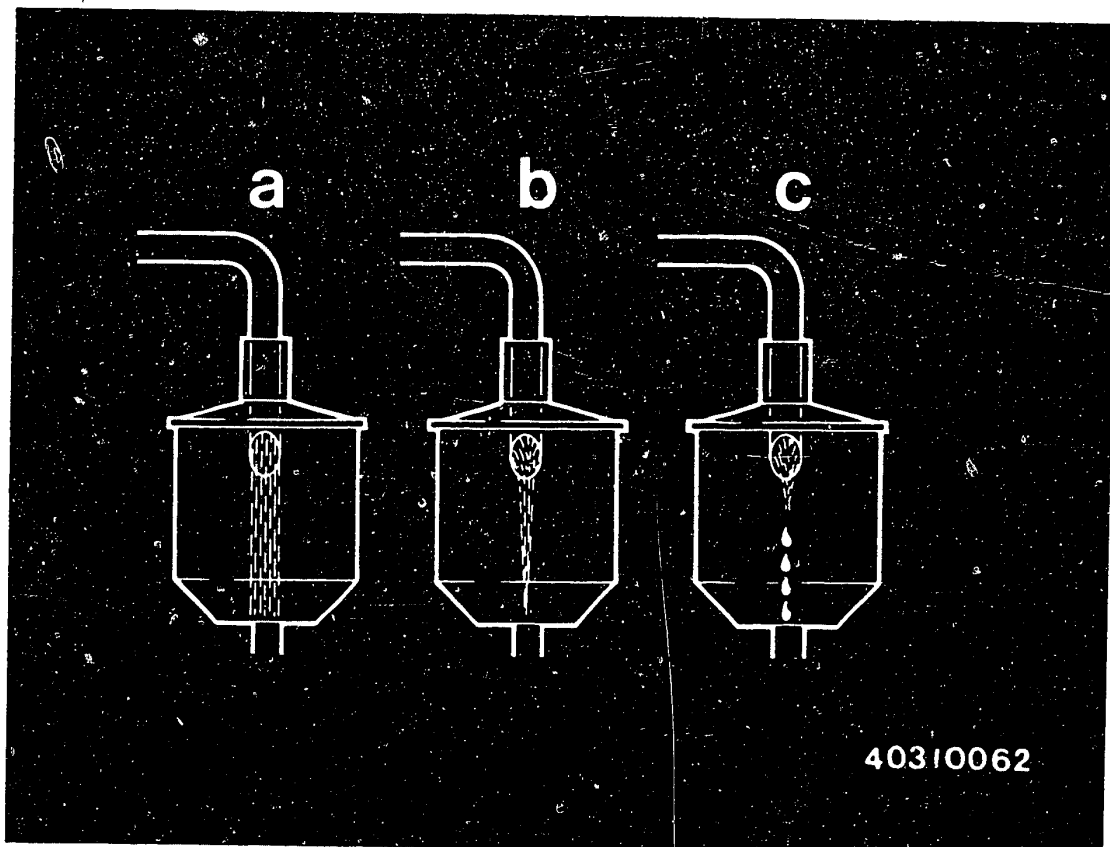
Connect electric leads of start-of-delivery setting device to vehicle battery (12 V) (red cable to battery +). Fill fuel tank of device with diesel fuel. Turn crankshaft over twice in engine direction of rotation and set to approx. 35° BTDC on compression stroke of cylinder 1 (valve overlap on cylinder 4). Press injection-pump control rod to full load. Switch on start-of-delivery setting device.

H9

Injection timing

Mercedes Benz 190 D



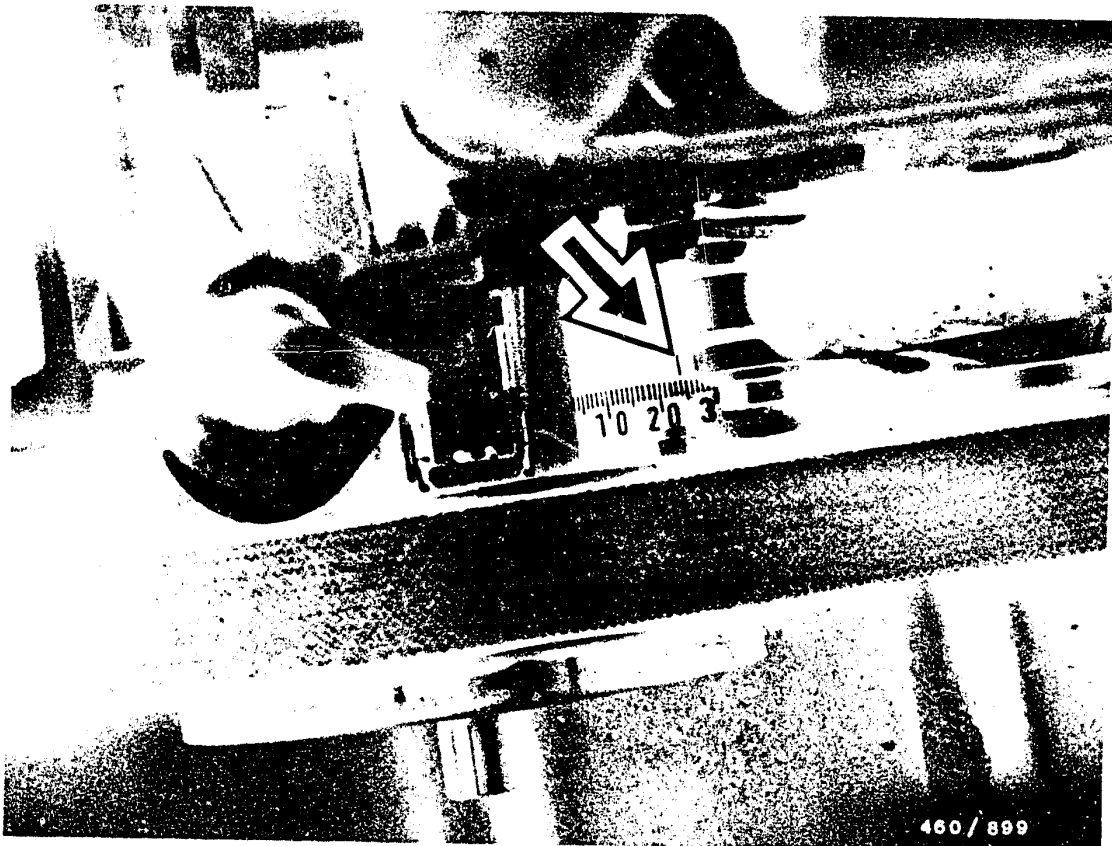


40310062

- a = Full fuel jet
- b = Tapered fuel jet just before start of delivery
- c = Chain of drips - start of delivery

Note: Switch on start-of-delivery setting device only for measuring. If injection nozzles are leaking, it is otherwise possible for fuel to enter the combustion chamber.

Slowly turn engine further in direction of rotation. While doing this, observe fuel jet in sight glass. The start of delivery has been reached when the fuel jet changes into a chain of drips.



In this position the engine marks for the start of delivery must align (see picture).

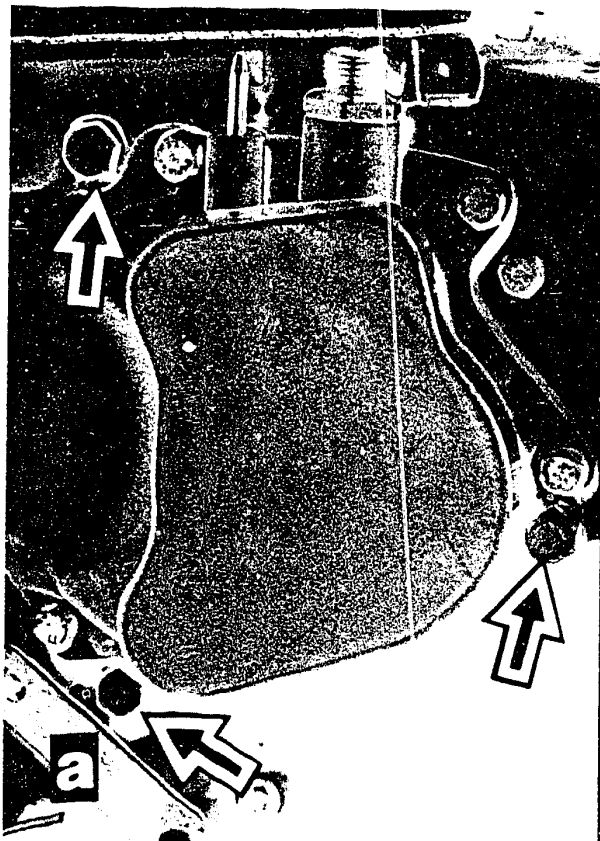
Set value 24° before TDC.

If set value not reached, a correction is necessary.

Adjusting:

Turn engine over 2 full times in direction of rotation and set to start-of-delivery mark 24° BTDC on compression stroke of cylinder 1 (cylinder 4 on overlap) (see picture, arrow).





Loosen injection-pump fastening screws at drive end (arrows, picture a) and on support bracket (arrow, picture b).

Press injection-pump control rod to full load.

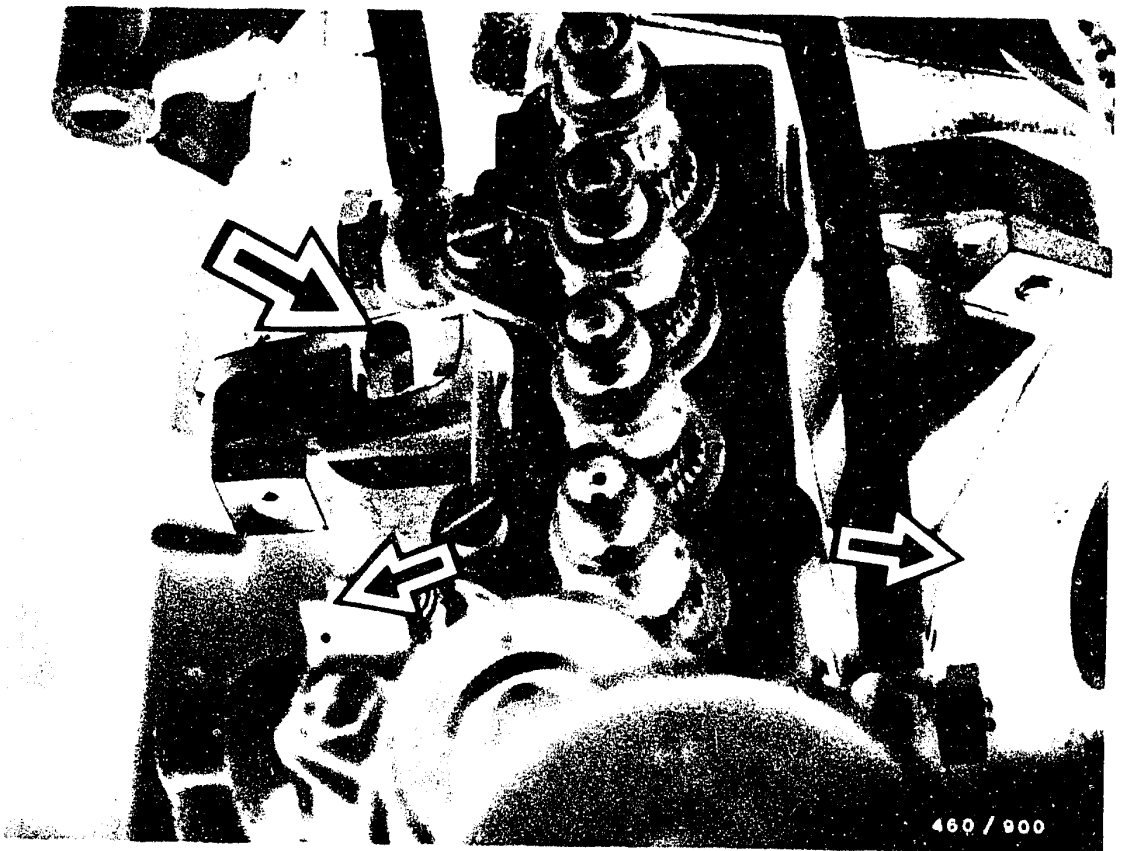
Switch on start-of-delivery setting device.

H12

Injection timing

Mercedes Benz 190 D





Pivot injection pump by turning the adjusting screw (see picture, arrow) until the fuel jet in the sight glass changes into a chain of drips.

Turning the adjusting screw to the right = start of delivery comes later

Turning the adjusting screw to the left = start of delivery comes earlier.

If the range of adjustment is not enough, the injection pump must be relocated.

Then repeat test of start of delivery.

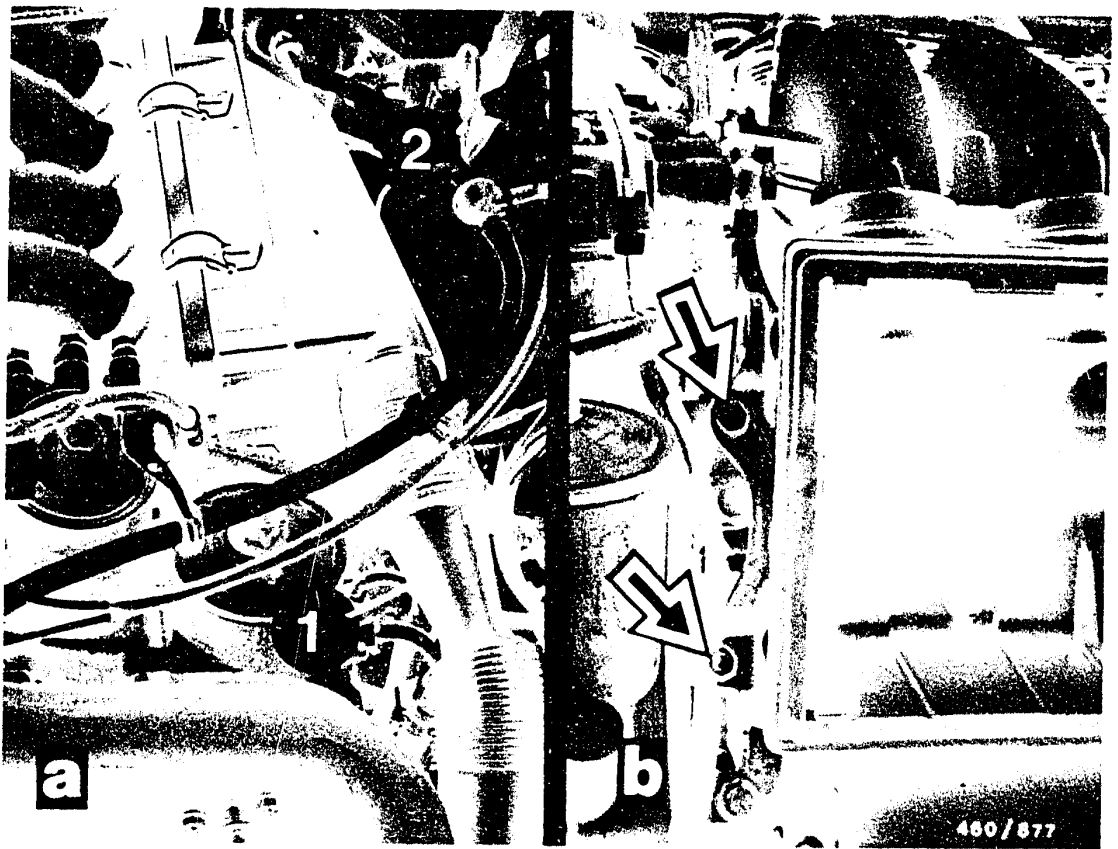
Switch off start-of-delivery setting device and remove accessories. Tighten injection-pump fastening screws (20...25 Nm). Remove screw plug from injection-pump return. Connect return line. Mount injection line on cylinder 1.

H13

Injection timing

Mercedes Benz 190 D





- 1 = Air intake dome
2 = Air filter cover

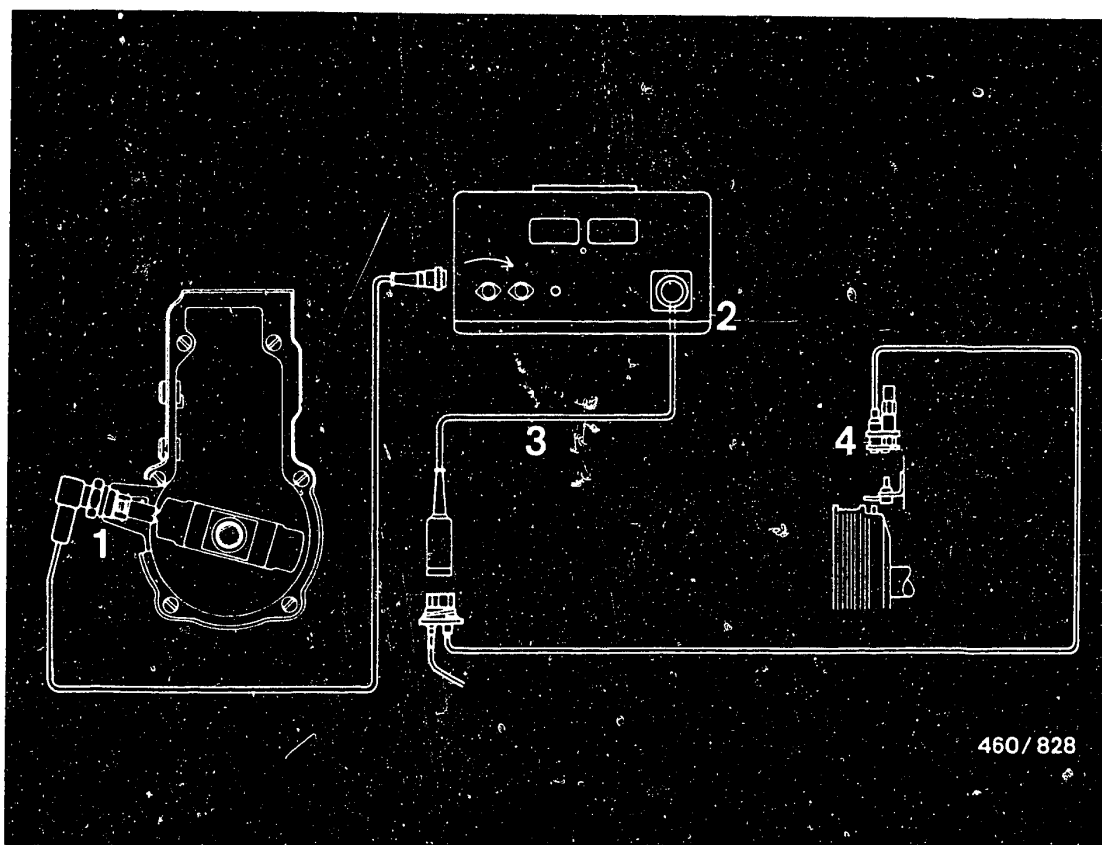
Mount air guide housing (see picture b)
Mount air filter cover and slide on air intake dome.

Note:

The injection system bleeds itself automatically when the engine is started.

Let engine run and test all connections for leaks.





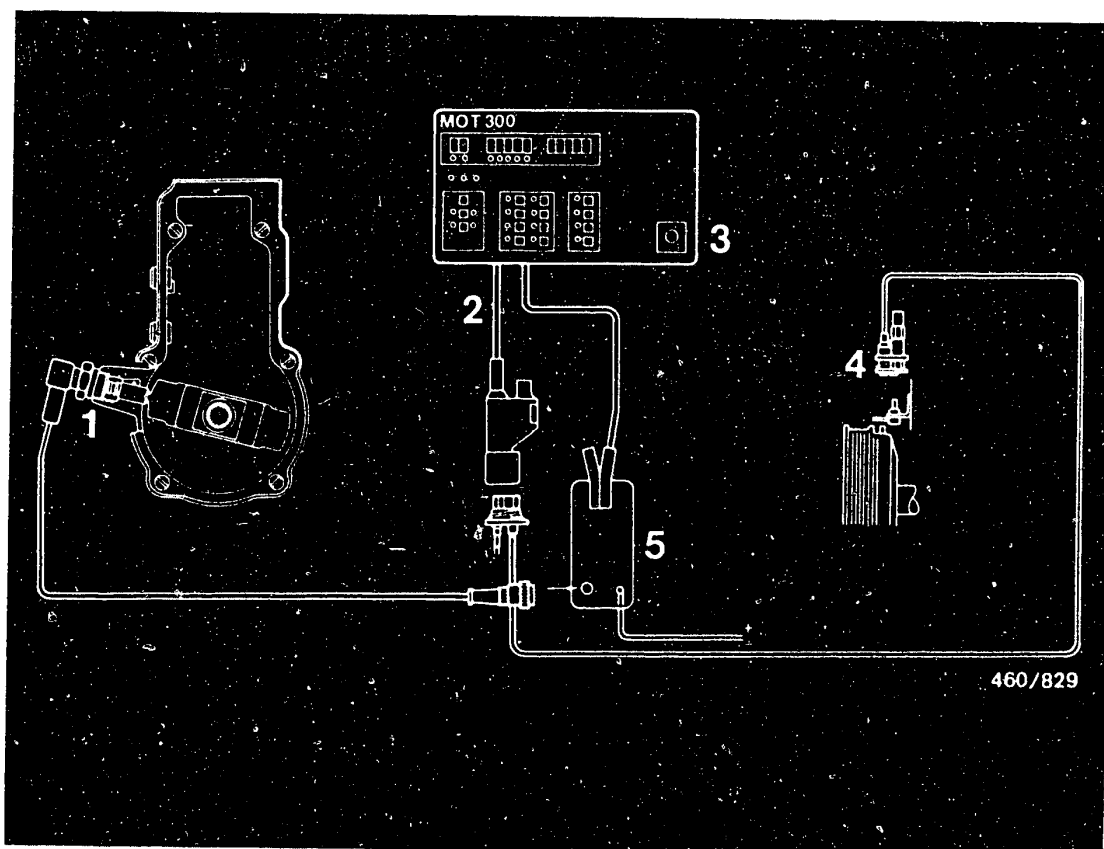
460/828

- 1 = Governor pulse generator, Daimler Benz part no. 617 589 102 100
- 2 = Diesel engine tester ETD 019.00, Bosch part no. 0 684 101 900
- 3 = Adapter line, Bosch part no. 1 684 463 147
- 4 = TDC pickup, Daimler Benz part no. 601 589 042 100

28.2. Dynamic testing of start of delivery

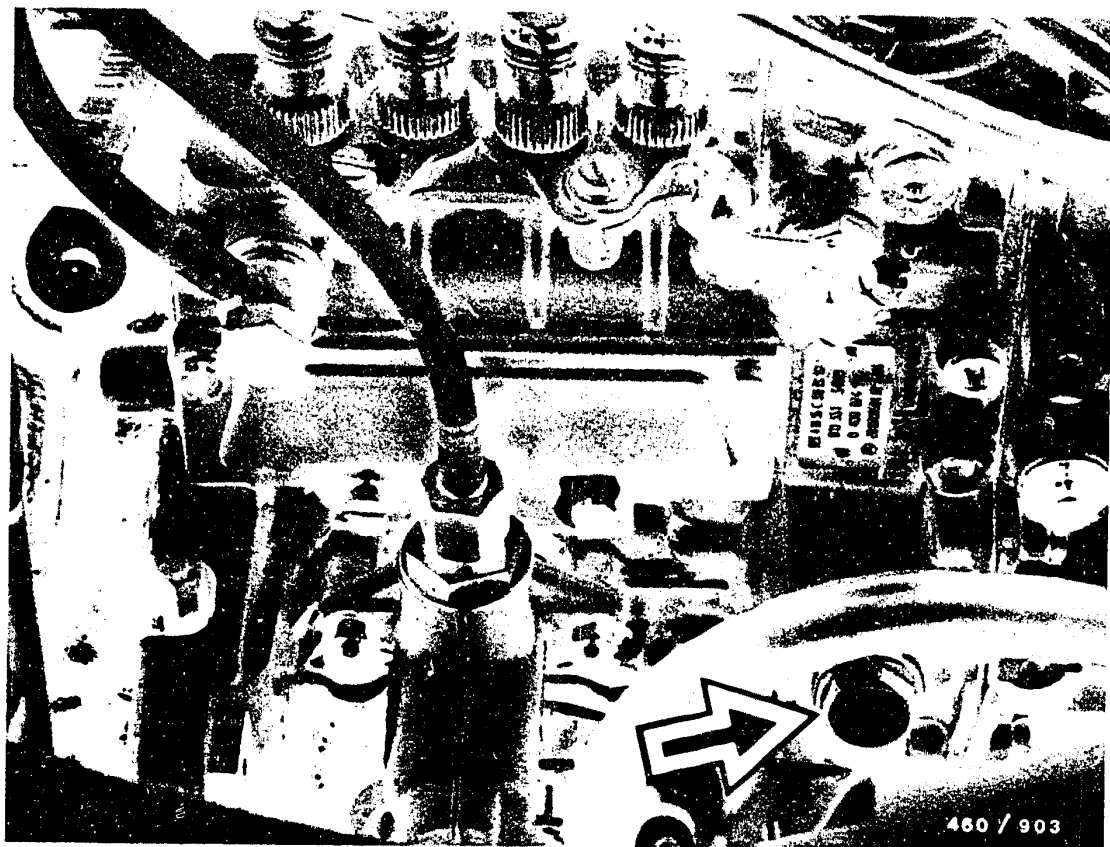
28.2.1 Connection diagram for dynamic testing of start of delivery with diesel engine tester ETD 019.00





- 1 = Governor pulse generator, Daimler Benz part no. 617 589 102 100
- 2 = Adapter line, Bosch part no. 1 684 463 094
- 3 = Motortester MOT 300, Bosch part no. 0 684 000 300
- 4 = TDC pickup, Bosch part no. not yet specified
- 5 = Ballast unit, Bosch part no. not yet specified

28.2.2 Connection diagram for dynamic testing of start of delivery with ballast unit and motortester (e.g. MOT 300)



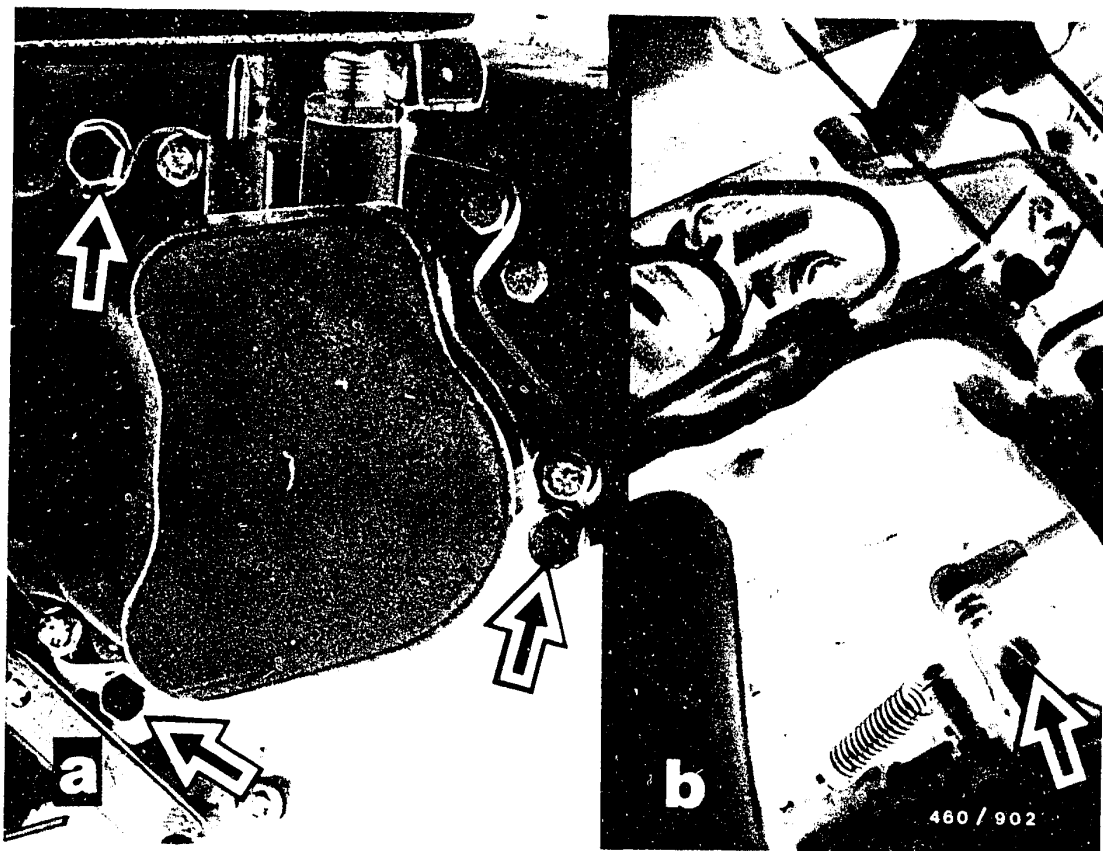
Remove screw plug (see picture, arrow) from governor.
 Screw in governor pulse generator.
 Mount TDC pickup on bracket (engine).
 Connect governor pulse generator and TDC pickup in
 accordance with connection diagram.
 Run engine at idle speed ($750 \pm 50 \text{ min}^{-1}$).
 Read off governor pulse reading on motortester or diesel
 engine tester.
 Set value: $-15 \pm 1^\circ \text{ ATDC}$

H17

Injection timing

Mercedes Benz 190 D





If set value not reached, injection pump must be turned.

Adjusting:

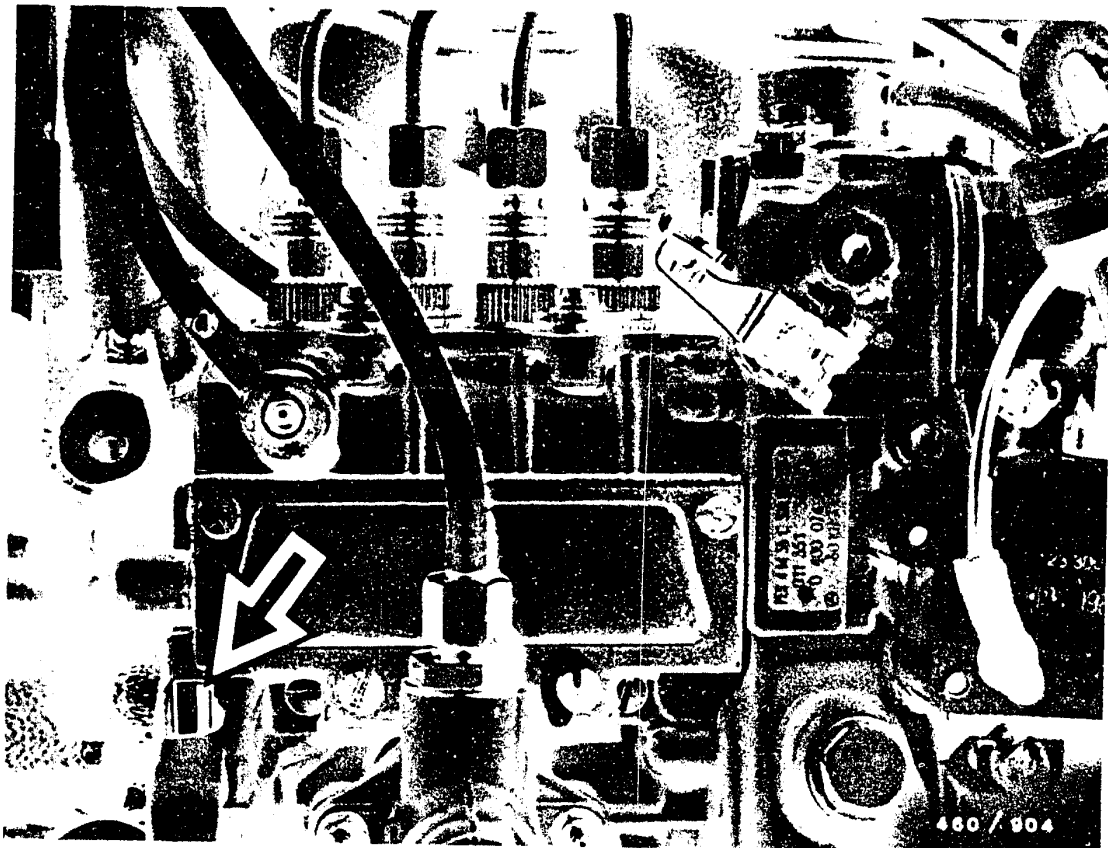
Loosen injection-pump fastening screws at drive end (arrow, picture a) and on support bracket (arrow, picture b).

H18

Injection timing

Mercedes Benz 190 D





Run engine at idle ($750 \pm 50 \text{ min}^{-1}$).

Set injection pump to set value - 15° ATDC by turning the adjusting screw (see picture, arrow).

Turning the adjusting screw to the right = start of delivery comes later

Turning the adjusting screw to the left = start of delivery comes earlier.

If the range of adjustment of the adjusting screw is not enough, relocate the injection pump.

Stop engine. Disconnect tester. Screw screw plug with seal into governor again. Check engine oil level.



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